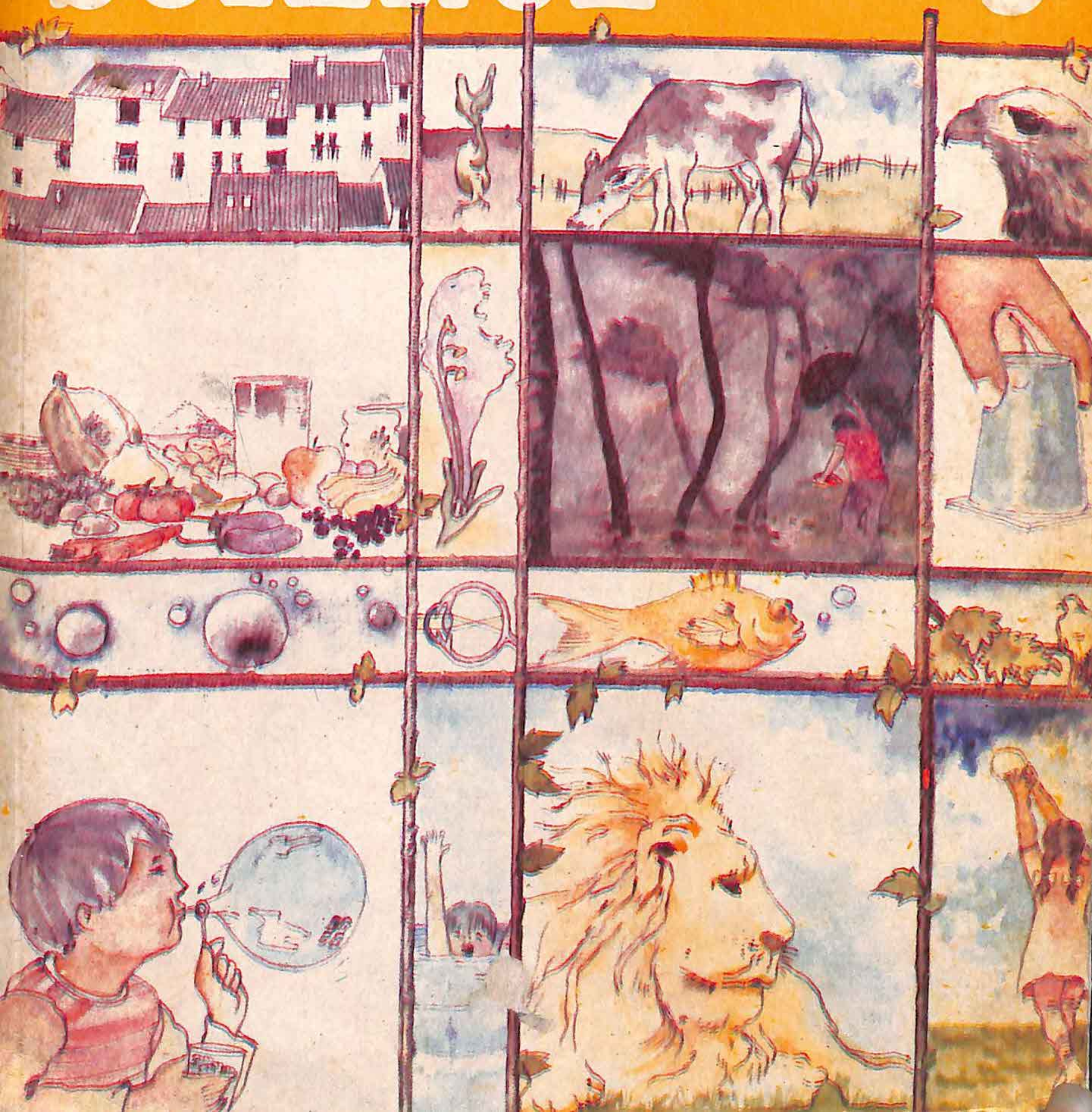
DISCOVERING SCIENCE 5



DISCOVERING SCIENCE

BOOK 5

GOMATHI KRISHNAMACHARI
Vidya Mandir Higher Secondary School
Madras

I.B. KAKAR
Principal, Army Public School
Delhi

UMA NATARAJAN
Vidya Mandir Higher Secondary School
Madras

Illustrations: LALITHA

Sangam Books

NOTE TO THE TEACHER

In the course of writing these books, some decisions have been taken with the recognition that this is a course for the primary level. The terminology and vocabulary must therefore be exact without emotionally distancing the young learner.

The teacher's attention is also drawn to the fact that for some plants, fruits and vegetables, the *most* familiar names have been used since there are regional variations. It seemed appropriate, for instance to say *lady's fingers* and *brinjal* instead of *okra* cr *aubergine*. Wherever necessary, the teacher is advised to substitute words that are better understood for such words. However, it is also recommended that 'internationally' understood words are introduced at the appropriate level so that they pass into the learner's passive vocabulary.

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PREFACE

Discovering Science offers a new and challenging set of texts which has grown out of modern approaches to learning and teaching science. The five books in the primary series are based chiefly on the syllabus and recommendations of the National Council of Educational Research and Training (NCERT). The books also take into account the syllabuses of other primary-school systems.

The series presents science as the logical, exact discipline it is. The concepts of interdependence and of cause-effect in natural phenomena are clearly established. In the text, as in the exercises, science emerges as knowledge bound up closely with everyday life. A sense of ecology is also developed in a simple manner.

The texts are profusely illustrated, and are planned with a view to stimulating the child's interest and curiosity. The exercises should serve not only to recapitulate what has been learnt, but to create lines for thinking, interpretation, deduction, classification — all of these appropriate to the age-level. Due account has been taken of the possibilities and limitations of the classroom.

The authors and publishers are grateful to the many teachers consulted in the preparation of the books. They are likewise grateful to the artists who have designed and illustrated the books.

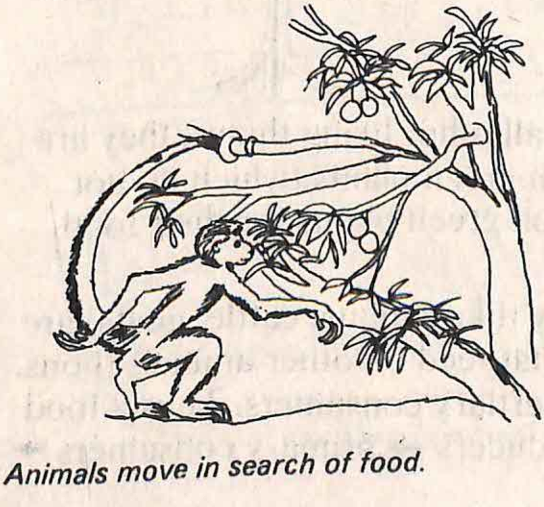
UNIT I *LIVING THINGS*

1. Living things and their environment

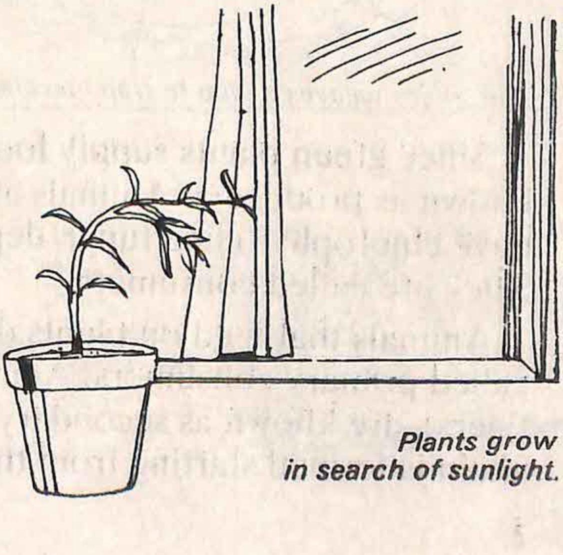
Life is all around us. It is in the fields; on the streets and in the gardens; in the streams and in the lakes; in the air around us and in the oceans. Life is present in different forms on the frozen North Pole; in the dry sandy deserts of the Sahara; on Mount Everest and at the bottom of the deepest sea.

To be alive means to be able to move; it means to be able to grow, feed, respire, excrete, reproduce and to be able to feel the changes that take place in one's surroundings. Both animals and plants share all these life activities but also show a few differences as given below:

1. Animals move from one place to another in search of food and to escape from danger. Plants do not move from one place to another like animals do. Parts of plants move slowly. For example, young plants grow in search of sunlight; there is movement when a flower blooms or when the leaves of some plants close at night. Plants do not need to move to obtain food because they have chlorophyll and therefore can prepare their own food.



Animals move in search of food.

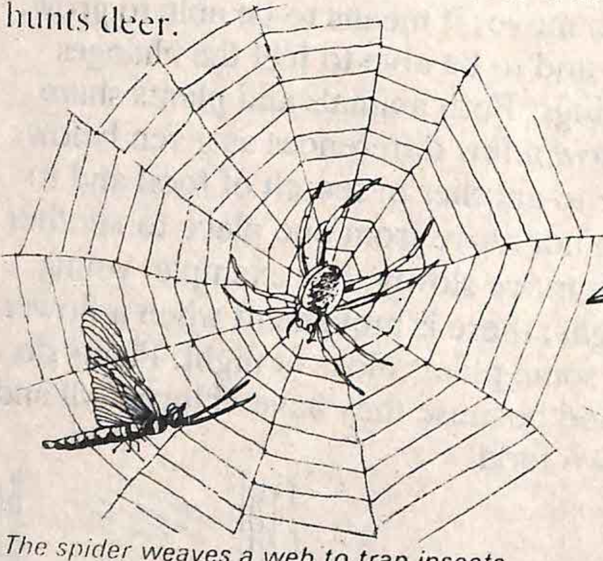


Plants grow in search of sunlight.

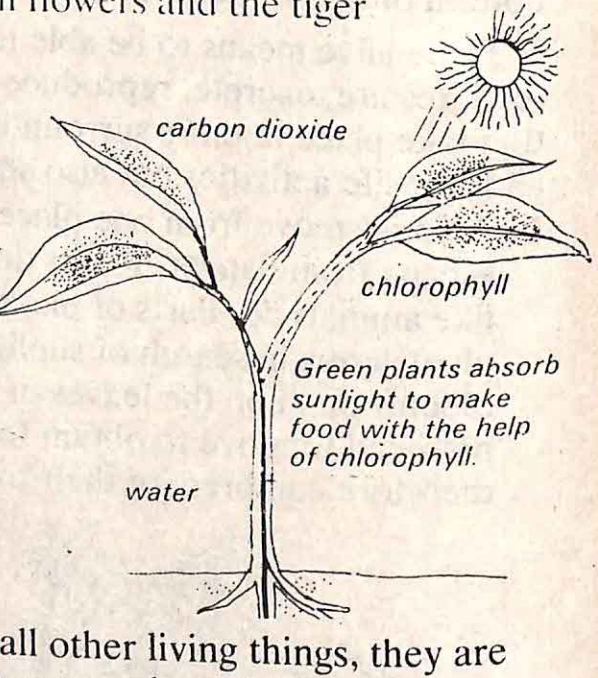
2. Animals exhibit strong feelings like pain, joy and sadness. Plants do not exhibit such feelings. This is because a plant does not have a brain, nerves and sense organs.
3. In general plants do not have the organised systems that most animals have.

The food chain

No living thing can live without food for long. Food gives energy which the body needs to carry out the activities of life. What each animal or plant uses for food and how each obtains it, varies from animal to animal and from plant to plant. Green plants absorb sunlight to make food with the help of chlorophyll; cattle and deer eat grass and other plants: the spider weaves a web to trap insects and eat them: the honeybee sucks nectar from flowers and the tiger hunts deer.



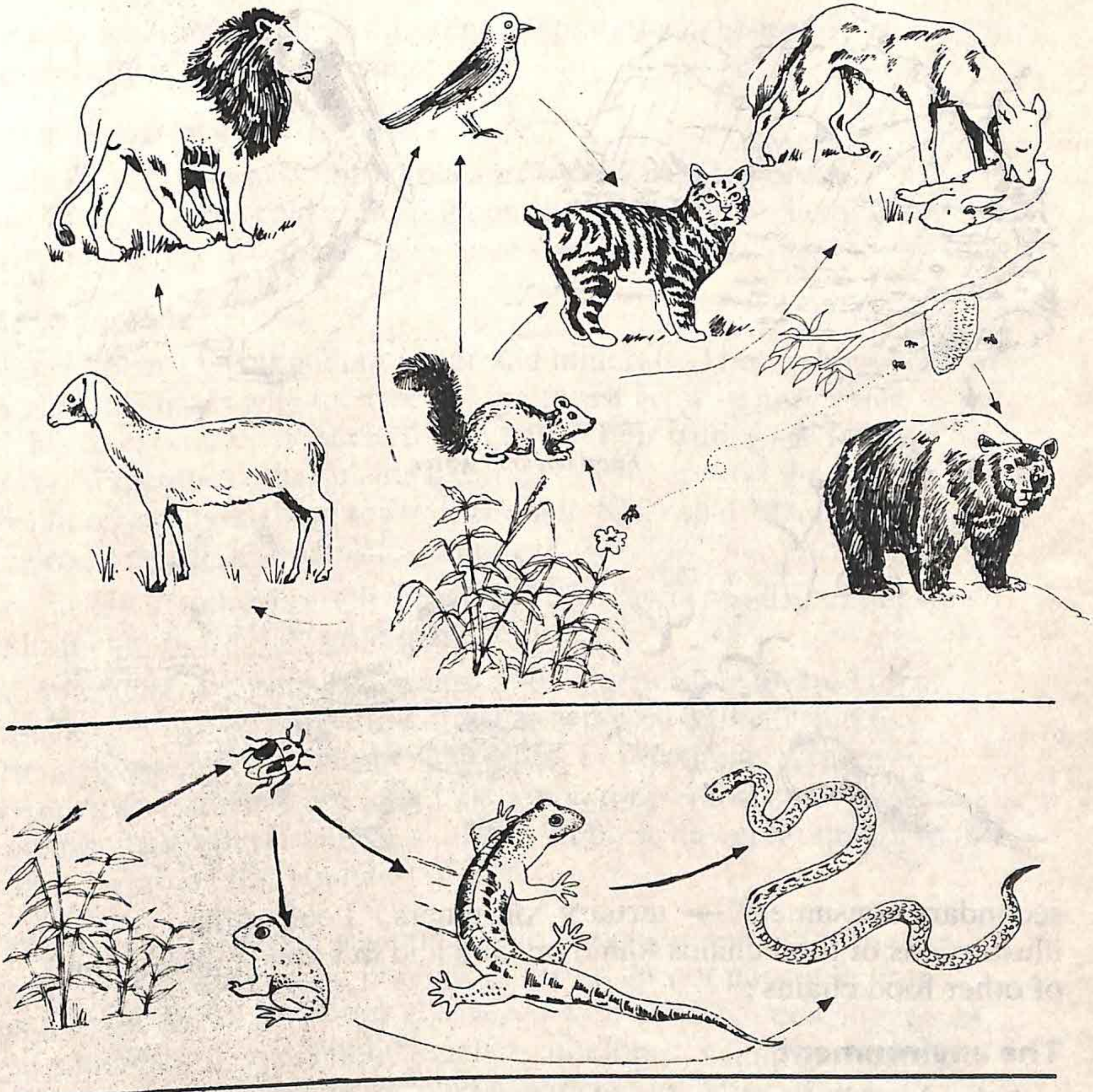
The spider weaves a web to trap insects.



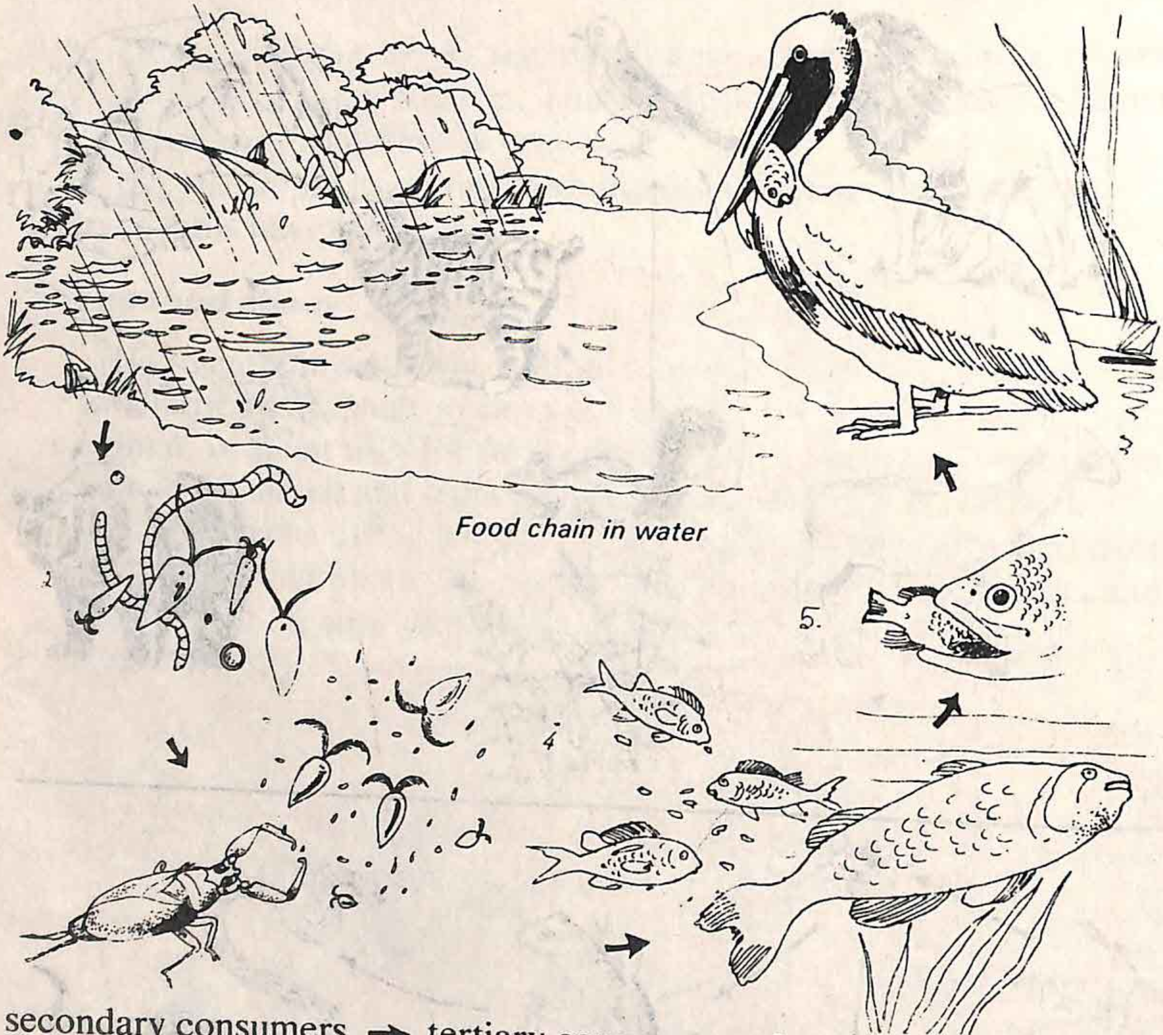
Green plants absorb sunlight to make food with the help of chlorophyll.

Since green plants supply food for all other living things, they are known as producers. Animals and non-green plants (which do not have chlorophyll) like fungi, depend on green plants for their food. They are called consumers.

Animals that feed on plants directly (like rabbits, cattle, goats) are called primary consumers. Animals that feed on other animals (lions, tigers) are known as secondary and tertiary consumers. Thus a food chain is formed starting from the producers → primary consumers →



Food chains on land



Food chain in water

secondary consumers → tertiary consumers. Look at the illustrations of food chains found on land and in water. Can you think of other food chains?

The environment

Animals and plants are found all over the world. They are seen in deserts, forests, seas, rivers, fields, ponds and on hills. The surrounding of a plant or an animal is known as its environment. Living things can be classified into three groups according to the environment they live in. These are:

1. those that live on land (terrestrial);
2. those that live in water (aquatic);
3. those that live in air (aerial).

Plants and animals show different adaptations in order to live successfully in these environments.

The terrestrial environment

Life can be seen in different places on land such as forests, grasslands, deserts, cold polar regions and mountains. The animals and plants inhabiting these areas have special adaptations.

Life in forests

Forest plants get abundant water and minerals. Their main problem is sunlight. That is why the trees of the forest grow to enormous heights to expose their leaves to sunlight. Their trunks are tall and sturdy. Sometimes other plants like vines twine around these giant trees in order to reach up towards the sun. Still other plants do not have roots and live as parasites on trees.

A variety of animals are found in the forests. These live either on the branches of trees or on the jungle floor.

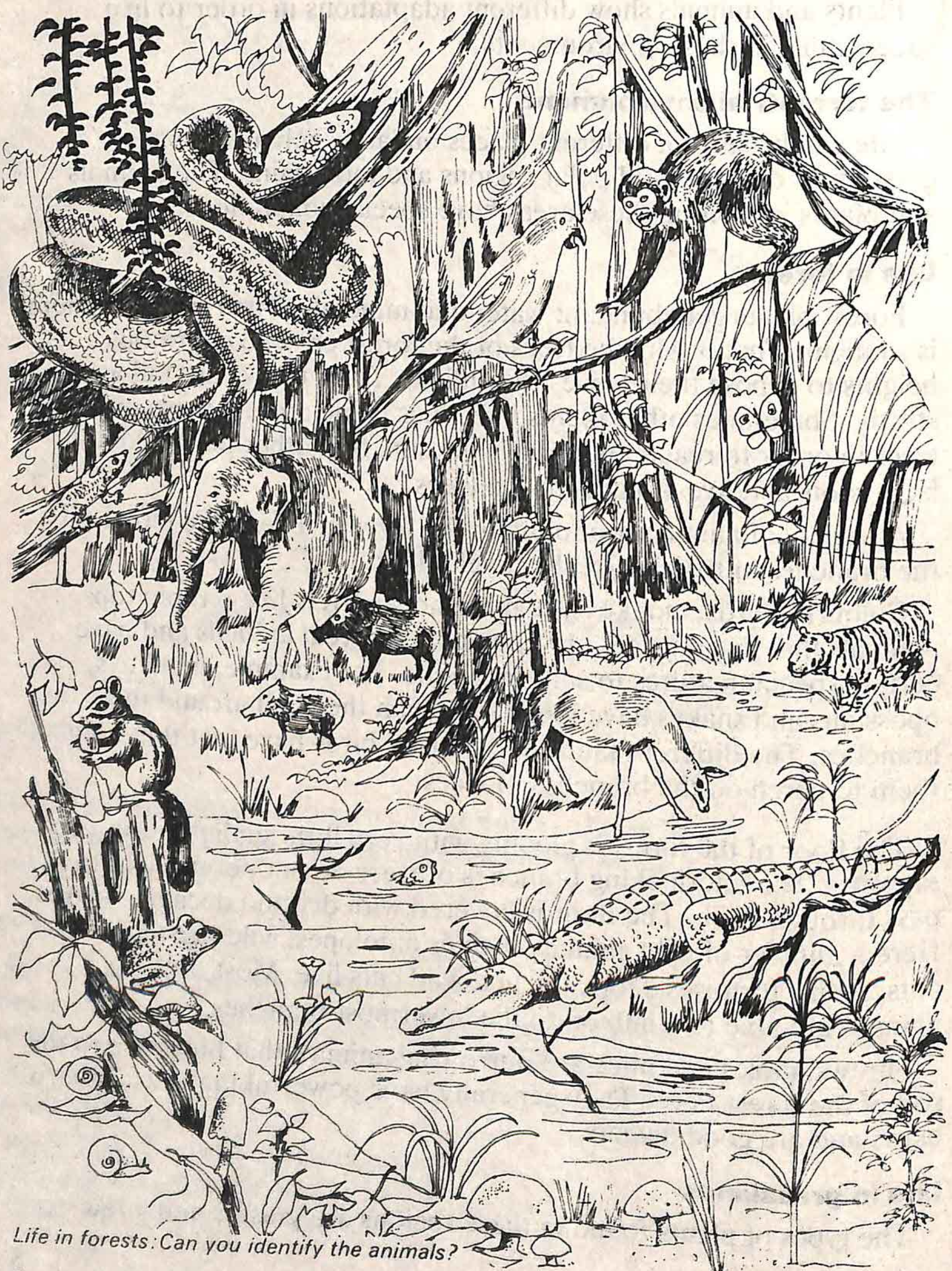
Colourful birds, monkeys, snakes and squirrels live on tree tops. Animals that live on trees are known as arboreal animals and have certain special features to suit such a life. For example, monkeys, opossums and snakes have long tails which they coil around the branches. The different kinds of colourful birds have feet that help them to perch on the branches of trees.

The floor of the forest is gloomy with very little sunlight. Can you say why? The interlocking branches of trees do not permit light to pass through them. The floor is covered with dry and decaying leaves. Here a number of wild animals such as antelopes, wild pigs, lizards, ants, snails, tortoises, leopards, and wild cats live. Most of these animals are able to climb on to the lowermost branches.

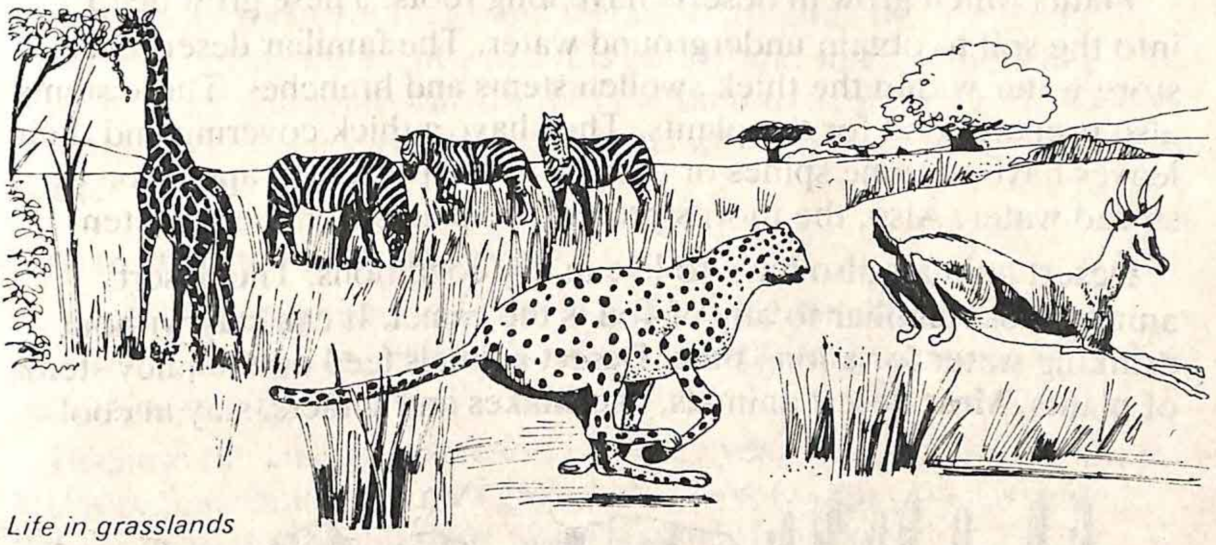
Shrews, moles and mice are burrowing animals that burrow into the soil of the forest floor. They generally have powerful limbs with sharp claws and are good diggers.

Life in grasslands

The types of plants found in these regions are grasses and a few



Life in forests: Can you identify the animals?



Life in grasslands

trees. The grasses growing here are constantly being eaten away by animals. So these plants repeatedly form new shoots from roots and underground stems.

A number of wild animals that feed on grasses and leaves and twigs of trees are found in grasslands – deer, gazelle, antelope, ox, zebra, wild buffalo, elephant, rhinoceros and giraffe.

These animals that feed on plants are in turn hunted by wild dogs, lions, tigers, leopards, cheetah and other wild cats.

Both hunters and hunted animals have adaptations to suit their way of life. The herbivorous animals like deer, gazelle, antelope and zebra always move in large numbers. They have very sharp senses of hearing and smell and will sense the approach of a lion or tiger long before they see it. All these animals are good runners and can easily escape unless they are very young, old or ill. Also, most of these animals have skins which are green, grey or brown and match their surroundings.

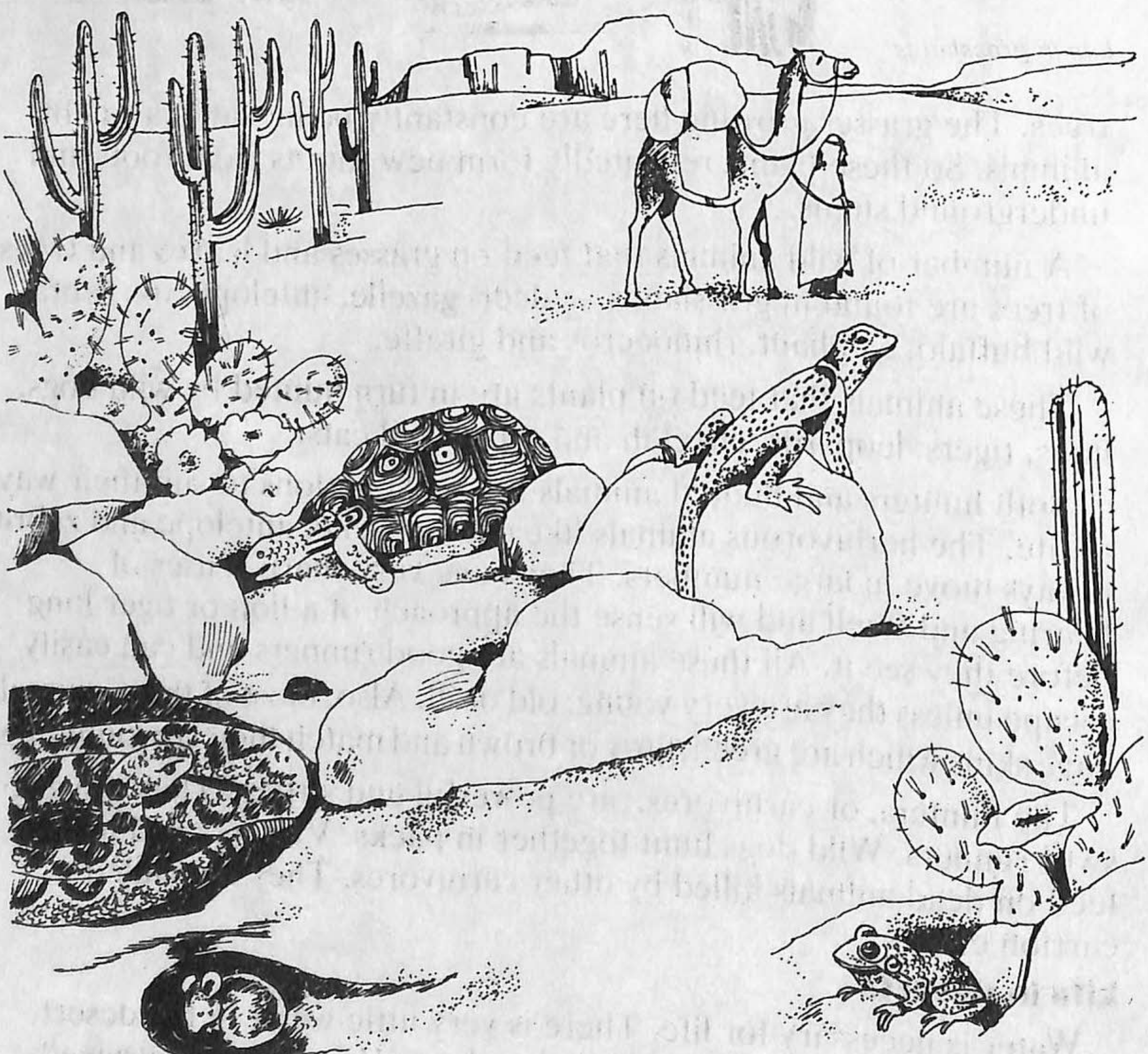
The hunters, or carnivores, are powerful and strong. They are also swift runners. Wild dogs hunt together in packs. Vultures and hyenas feed on dead animals killed by other carnivores. They are called carrion eaters.

Life in deserts

Water is necessary for life. There is very little water in the desert. Yet there are plants and animals living there. How do they survive?

Plants which grow in deserts have long roots. These grow deep into the soil to obtain underground water. The familiar desert cacti store water within the thick swollen stems and branches. These stems also prepare food for the plants. They have a thick covering and their leaves have become spines or thorns. These prevent evaporation of stored water. Also, the thorns protect the plants from being eaten.

Desert animals also have to live in dry conditions. The desert animal most familiar to any of you is the camel. It can stay without drinking water for a long time. Desert animals feed on the juicy stems of plants. Most desert animals, like snakes and spiders, stay in cool



Life in deserts

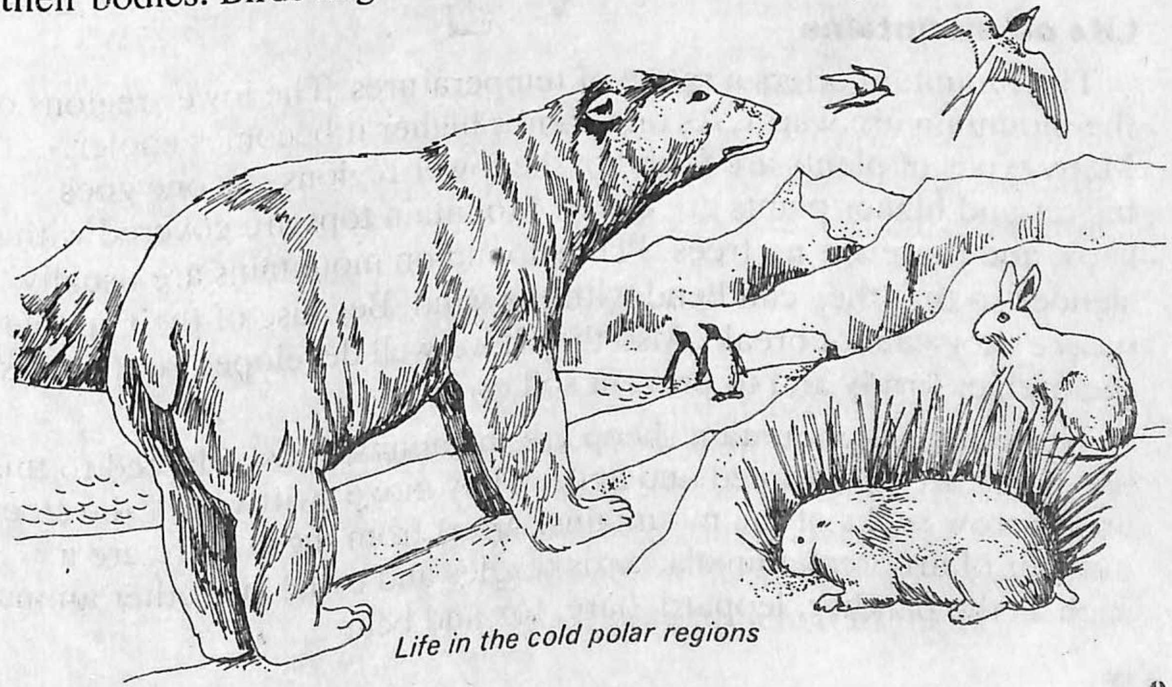
shady places (beneath rocks and stones) during the day time and come out during the night when it is cooler and safer. Others like lizards, frogs and toads burrow into the sand to avoid the heat. Desert animals and insects have thick dry skins which prevent evaporation of water.

Life in the cold polar regions

You will be surprised to know that these regions are similar to deserts! The regions near the North and South Poles are actually examples of cold deserts.

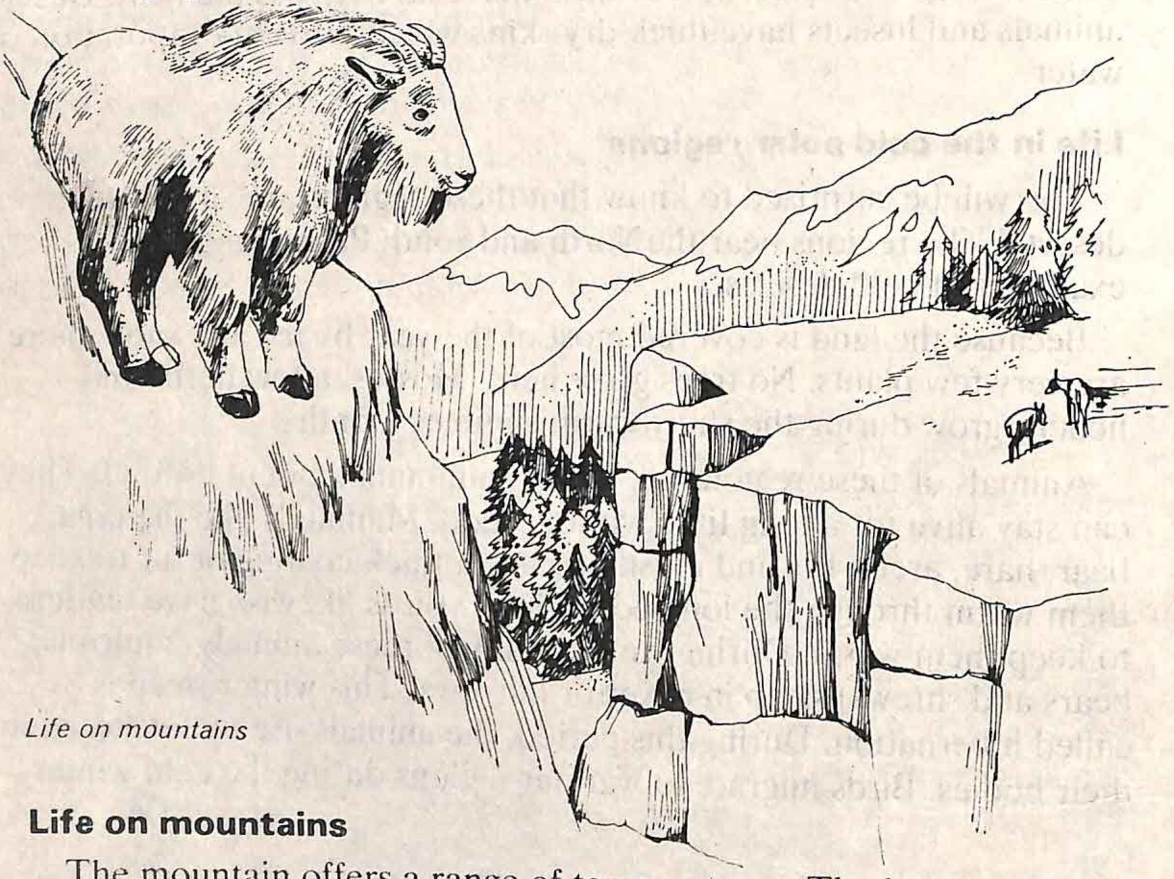
Because the land is covered most of the year by ice and snow there are very few plants. No trees grow here. Mosses, a few herbs and lichens grow during the short warm summer months.

Animals of these regions get only a minimum amount of food. They can stay alive for a long time without food. Mammals like the polar bear, hare, arctic fox and musk ox have a thick coating of fur to keep them warm through the long cold winter. Birds likewise have feathers to keep them warm. During winter many of these animals (squirrels, bears and shrews) sleep in caves or burrows. This winter sleep is called hibernation. During this period, the animals use up fat stored in their bodies. Birds migrate to warmer regions during the cold winter.



Life in the cold polar regions

The white feathers of some birds and white coats of some animals like the arctic fox, hare, lemming and polar bear serve as protective colouring against the white snow during winter.



Life on mountains

Life on mountains

The mountain offers a range of temperatures. The lower regions of the mountain are warm. As one climbs higher it becomes cooler. Many types of plants are found in the lower regions. As one goes higher and higher plants are fewer. Mountain tops are covered with snow and there are no trees. Plants found on mountains are usually slender so that they can bend with the wind. Because of their supple nature they cannot break. Also they have well developed roots to fix themselves firmly and to prevent soil erosion.

The goats and mountain sheep are the animals best adapted to this life. They are sure-footed and agile. They move swiftly over the steep and narrow rocks of the mountains. Apart from these there are a number of arboreal animals, birds (eagles and owls) and other animals such as the panther, leopard, hare, fox and bear.

The aquatic environment

Water is a more uniform environment than land. We can divide it into two parts — the fresh water of ponds, lakes, streams and rivers and the salt water of the seas and oceans. Both have a large number of plants and animals.

Life in fresh water

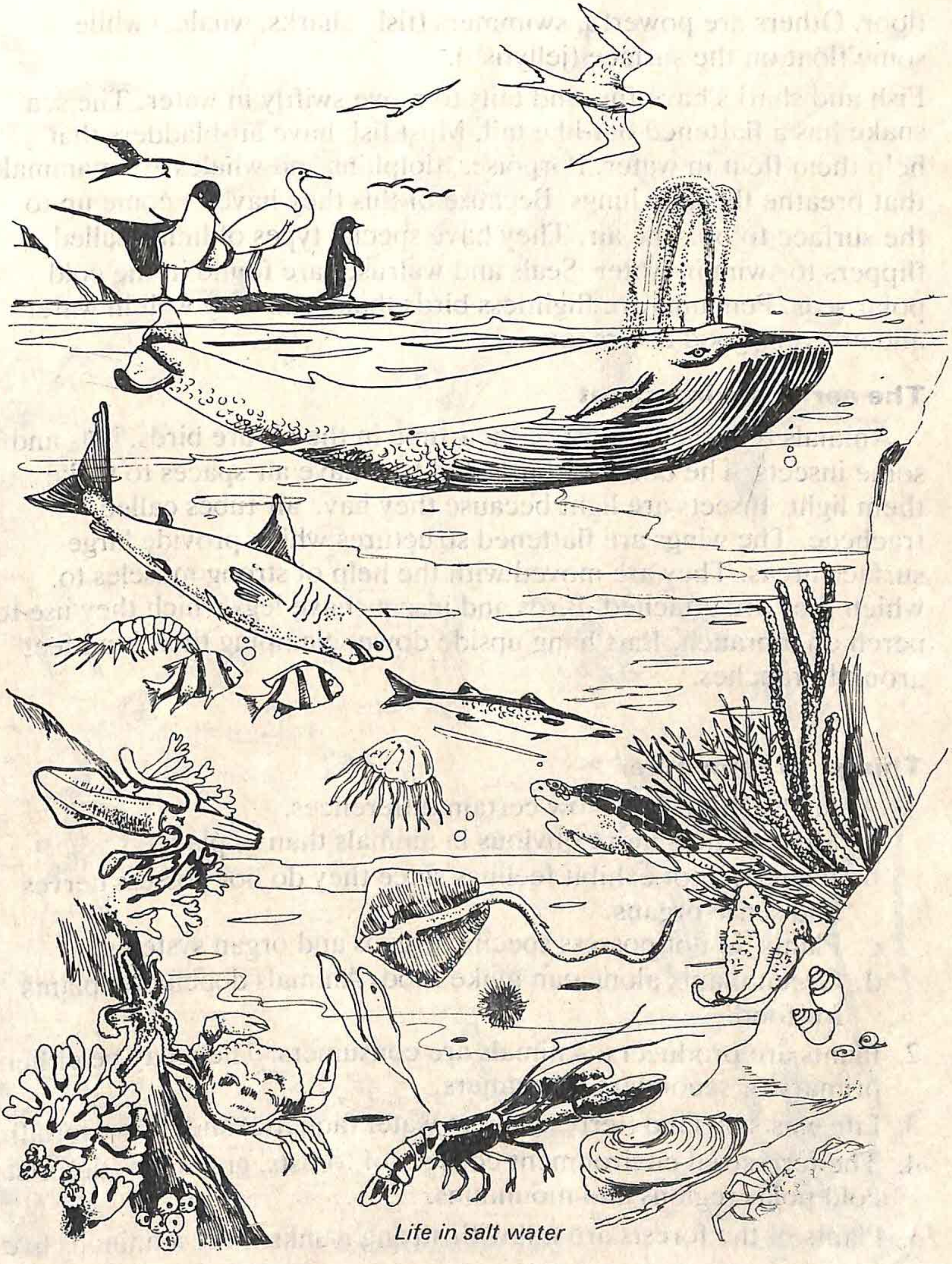
Some plants in ponds and lakes float on the water surface. Floating plants like the duckweed have small roots and are light. Some, like the water hyacinth, usually have flat leaves which may have air spaces to keep them afloat. Their roots are hairy. Their root tips are usually protected by root pockets. Plants that remain partially submerged (lilies, lotuses) or fully submerged (hydrilla) are fixed to the soil. They have long thin weak pliable stems that do not resist water currents. Streams and rivers also have many plants on their banks.

Animal life is diverse in fresh waters. Insects, snails, fishes, snakes, terrapins (fresh water turtles), crocodiles and a variety of water birds and other animals are found. These have waterproof skins and feathers. Fish have special breathing organs called gills. Their fins and tail help them in moving through the water. Crocodiles and terrapins have to come to the surface repeatedly in order to take air into their lungs. Water birds such as ducks are able to swim in water with their webbed feet. One of the most interesting animals is the frog. It is able to live on land and in water. In water it swims with its webbed toes and breathes through its skin. On land it breathes with the help of lungs. Tadpoles live completely in water and have fins and gills.

Life in salt water

The plants found in the seas and oceans are seaweeds and other tiny floating plants. No plants grow at the bottom of oceans and seas because there is no sunlight. A variety of animals found in the sea are lobsters, crabs, starfish, fish, turtles, sharks, snakes, whales, porpoises. A few of these crawl on the ocean floor (crabs, lobsters, starfish). Corals and sea anemones are found attached to the ocean

Life in fresh water



Life in salt water

floor. Others are powerful swimmers (fish, sharks, whales) while some float on the surface (jellyfish).

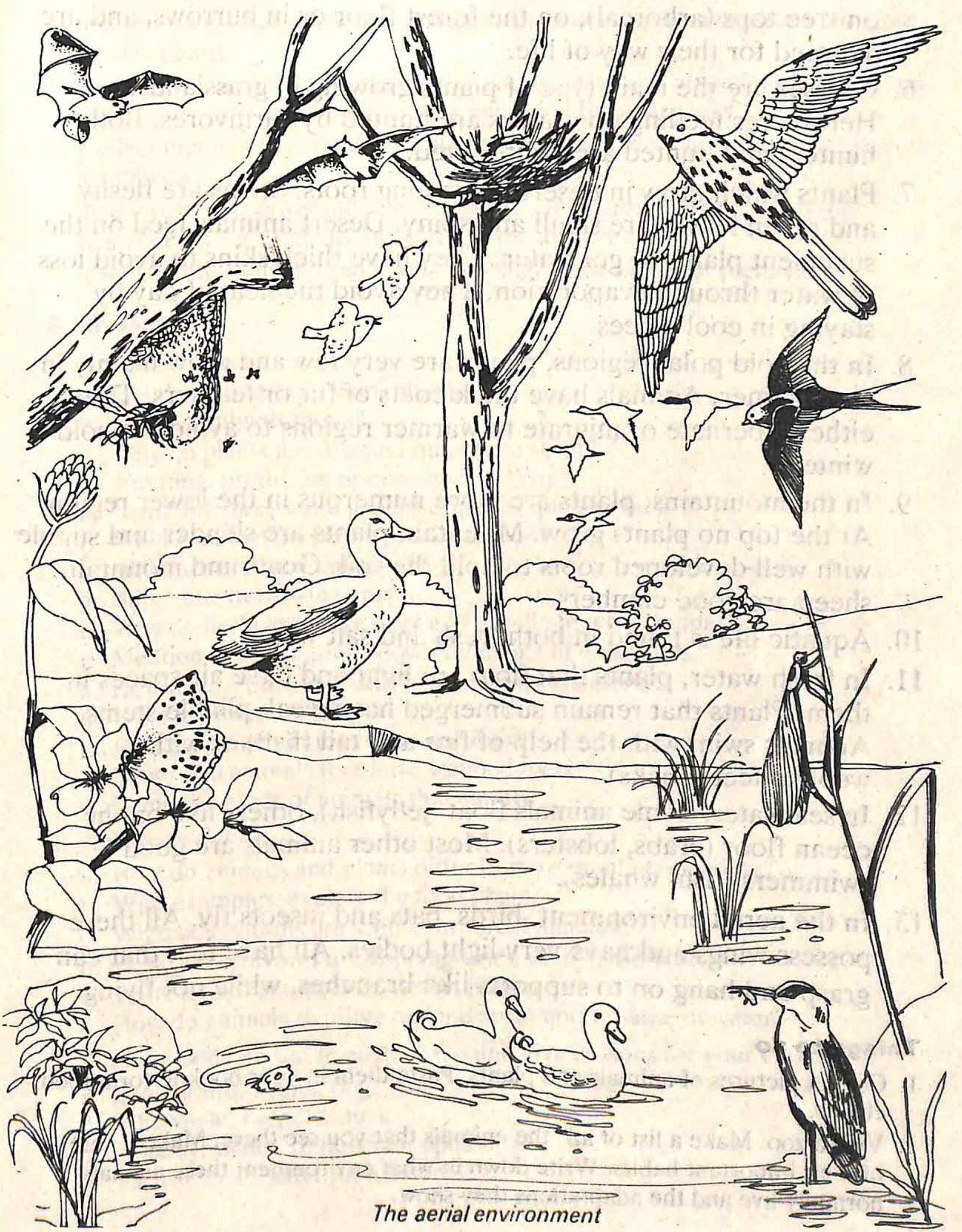
Fish and sharks have fins and tails to move swiftly in water. The sea snake has a flattened oar-like tail. Most fish have air-bladders that help them float in water. Porpoises, dolphins and whales are mammals that breathe through lungs. Because of this they have to come up to the surface to breathe air. They have special types of limbs called flippers to swim in water. Seals and walruses are found in the cold polar seas. Penguins are flightless birds that swim very well in water and are very good divers too.

The aerial environment

Animals that spend most of their time in the air are birds, bats and some insects. The bones of birds and bats have air spaces to make them light. Insects are light because they have air tubes called tracheae. The wings are flattened structures which provide large surface areas. They are moved with the help of strong muscles to which they are attached. Birds and insects have legs which they use to perch on a branch. Bats hang upside down, clamping their hind feet around branches.

Things to remember

1. Animals and plants show certain differences.
    a. Movement is more obvious in animals than in plants.
    b. Plants do not exhibit feelings since they do not possess nerves and sense organs.
    c. Plants do not possess specific organs and organ systems.
    d. Green plants alone can make food. Animals depend on plants for food.
2. Plants are producers. Animals are consumers. They may be either primary or secondary consumers.
3. Life exists on land (terrestrial), in water (aquatic) and in air (aerial).
4. The terrestrial environment consists of forests, grassland, deserts, cold polar regions and mountains.
5. Plants of the forests are tall with strong trunks. Forest animals live



The aerial environment

on tree tops (arboreal), on the forest floor or in burrows, and are adapted for their way of life.

6. Grasses are the main type of plants growing in grasslands. Herbivores feeding on grasses are hunted by carnivores. Both hunters and hunted are swift-footed.
7. Plants which grow in deserts have long roots. Stems are fleshy and green leaves are small and spiny. Desert animals feed on the succulent plants to get water. They have thick skins to avoid loss of water through evaporation. They avoid the heat of day by staying in cool places.
8. In the cold polar regions, plants are very few and grow mainly in the summer. Animals have thick coats of fur or feathers. They either hibernate or migrate to warmer regions to avoid the cold winter.
9. In the mountains, plants are more numerous in the lower region. At the top no plants grow. Mountain plants are slender and supple with well-developed roots to hold the soil. Goats and mountain sheep are good climbers.
10. Aquatic life is found in both fresh and salt water.
11. In fresh water, plants that float are light and have air spaces in them. Plants that remain submerged have weak pliable stems. Animals swim with the help of fins and tail (fish) or with webbed feet (ducks).
12. In sea water, some animals float (jellyfish), others live on the ocean floor (crabs, lobsters). Most other animals are good swimmers (fish, whales).
13. In the aerial environment, birds, bats and insects fly. All these possess wings and have very light bodies. All have feet that can grasp and hang on to supports like branches, while not flying.

Things to do

1. Collect pictures of animals and plants. Paste them in your book to form food chains.
2. Visit a zoo. Make a list of all the animals that you see there. Make a note of their important habits. Write down in what environment these animals normally live and the adaptations they show.

3. Visit an aquarium. Make a note of the types of animals that live in fresh water and sea water. Note their body shapes. Draw and colour them for your class display board.
4. Next time you visit a hill station observe the trees and animals that are found there. Note how the roots of plants penetrate through rocks!
5. Collect pictures of animals and plants. Construct the following scenes in your scrapbook.

   a. a forest; b. grassland; c. a desert; d. a mountain; e. a pond;
   f. an ocean; g. animals and birds in the air.

   You can draw animals and plants of which you cannot get pictures.

Exercises

1. Answer briefly:
   - a. List the activities of living things.
   - b. Why do animals move?
   - c. Why do plants not respond quickly to stimuli?
   - d. Are fungi producers or consumers? Why?
   - e. Name the three main groups of plants and animals.
   - f. What problem do plants in forests face?
   - g. What are arboreal animals?
   - h. Name one burrowing animal.
   - i. Why do herbivores like deer and gazelle move in herds?
   - j. Mention an adaptation shown by plants of grasslands.
   - k. How does a thick dry skin help animals in deserts?
   - l. What is hibernation?
   - m. Why do mountain tops have no trees?
   - n. Name two animals that have webbed feet.
   - o. Name the kinds of animals that can fly.
2. Answer in detail:
   - a. How do animals and plants differ in movement and feeding?
   - b. With examples, explain the food chain.
   - c. What adaptations are seen in arboreal animals?
   - d. How do herbivores avoid being eaten up by carnivores?
   - e. Write a few sentences on desert plants.
   - f. How do animals that live on land swim and breathe in water?
3. Find the odd one out in each group and give reasons for your choice.
   - a. lion, giraffe, hyena, dog
   - b. fish, whale, tadpole, duck
   - c. monkey, snake, rhinoceros, opossum
   - d. starfish, crab, jellyfish, lobster

e. penguin, crow, hawk, sparrow.

4. Tick the correct word :
   a. burrowing animal (shrew, cockroach, squirrel, cat)
   b. desert plant (tamarind, cactus, fir, neem)
   c. hibernating animal (frog, snake, cheetah, polar bear)
   d. arboreal animal (rat, anteater, monkey, goat)
   e. an aquatic plant (pine, mango, hydrilla, cactus)
   f. a sea water animal (jellyfish, terrapin, crocodile)
   g. an aerial animal (sparrow, ostrich, penguin, hen)
   h. a fresh water animal (shark, porpoise, starfish, terrapin)
5. State which organ (gills, lungs, tubes) helps each of these animals to breathe.

a. whale	d. crocodile
b. shark	e. bird
c. tadpole	f. cockroach

6. I am a plant. Where do I live?
   a. I am very tall and sturdy.
   b. I have a fleshy thorny stem with no leaves.
   c. I have flat leaves and air spaces.
   d. I am slender so that the wind cannot break me.
   e. I grow quickly from underground stems.
7. Fill in the table.

Type of animal	Type of environment	Adaptation
a. porpoise		
b. polar bear		
c. goat		
d. camel		
e. monkey		

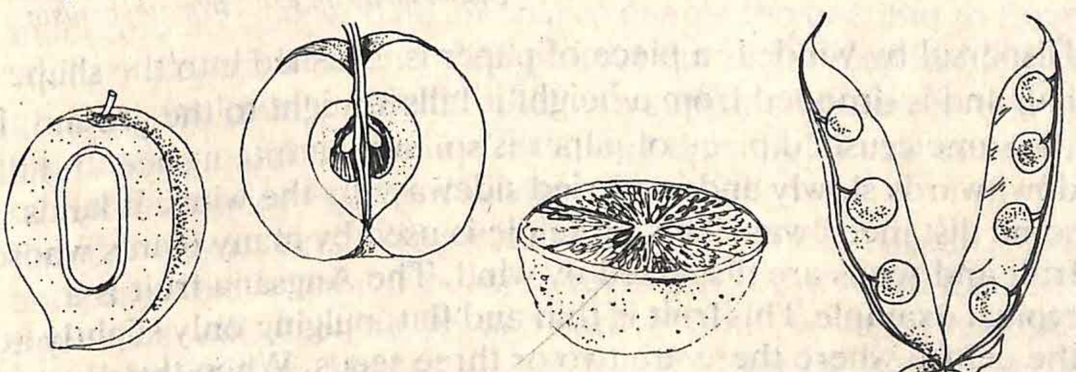
8. Arrange the living things in each group into a food chain.
   a. frogs, snakes, insects, sunflower plant
   b. mulberry plant, sparrow, cat, caterpillar
   c. kingfisher, tadpole, fish, weed
   d. man, leaf, worm, chicken

2. Raising plants through different means

All animals depend (directly or indirectly) on plants for food. This means that plants are being eaten up all the time. Because of this they have to reproduce themselves constantly in large quantities. This they do in many ways. Plant reproduction can be divided into two main groups—new plants from seeds and new plants from old plants. Some plants may even use both types of reproduction.

New plants from seeds

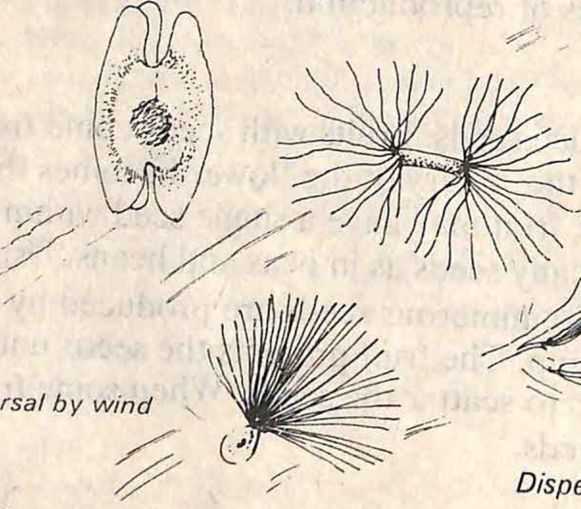
Most flowering plants produce seeds. Fruits with seeds come from the flower. After fertilisation, the ovary of the flower becomes the fruit and the ovule the seed. A fruit may have a single seed within it as in the mango or it may have many seeds as in peas and beans. Usually a plant produces many fruit. So numerous seeds are produced by a plant before it dies or is eaten up. The fruit protects the seeds until they mature. It then also helps to scatter the seeds. When some fruit burst open, they scatter the seeds.

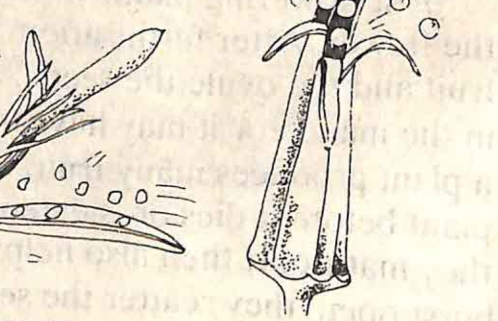


A fruit may have a single seed or it may have many seeds.

Plants are unable to move from place to place as animals can. They produce several thousand seeds in their lifetime. Imagine what would happen if all these seeds were to fall beside the plant and germinate. There would be no place for the thousands of saplings which would grow from them. So it is essential that the ripe seeds should be scattered far away from the parent plant. This scattering of seeds far away from the parent plant is called dispersal of seeds.

There are four main ways by which seeds are dispersed. These are 1. by wind; 2. by animals; 3. by water; 4. by an explosive mechanism. The seed of a land plant may fall in any place. It may fall in water, on the roof of a house or in a dry area. So, many seeds fall in places where they cannot grow into plants. Some seeds may also be eaten up by animals or birds. Seeds can grow into plants only if they fall on suitable moist soil and are left undisturbed. Do you now understand why plants produce many seeds?

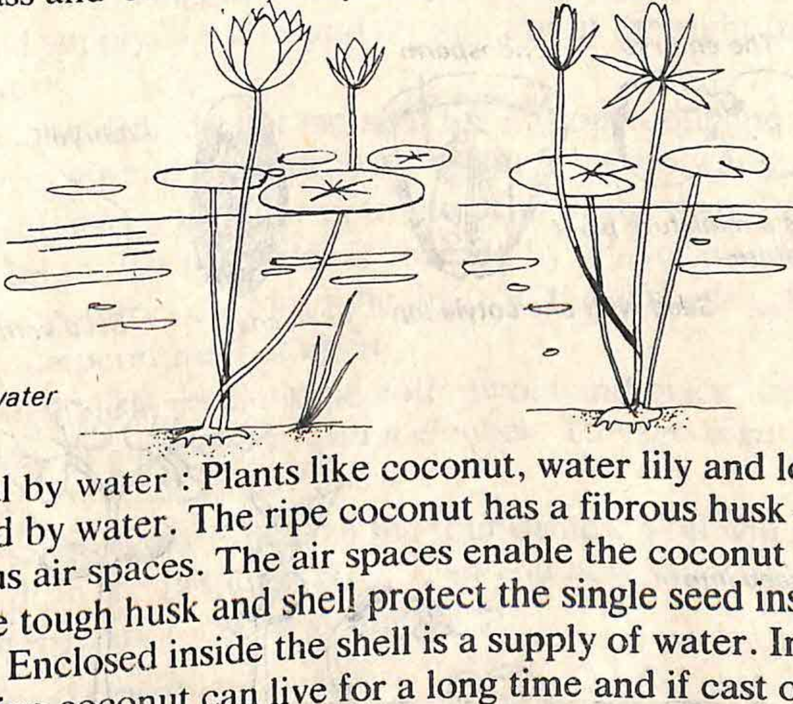

Dispersal by wind


Dispersal by an explosive mechanism

1. Dispersal by wind: If a piece of paper is crushed into the shape of a ball and is dropped from a height it falls straight to the ground. If the same crushed piece of paper is spread out into a sheet, it falls downwards slowly and is carried sideways by the wind. It lands some distance away. This principle is used by many plants whose fruit and seeds are dispersed by wind. The Angsana fruit is a typical example.This fruit is thin and flat, bulging only slightly at the centre where there are two or three seeds. When the dry and ripe fruit falls from the tall tree, it is carried some distance by the

wind before it falls to the ground. Some wind-dispersed fruit behave like shuttlecocks. The silk cotton seed has a bunch of silky hairs which act as wings. It is carried away by the wind to great distances.

2. Dispersal by animals: Birds peck at ripe fruit like tomatoes and guavas. They sometimes swallow not only the fleshy part but the hard seeds as well.The seeds remain undigested and are passed out unchanged some distance away, with the bird droppings. Some fruit like mangoes and jackfruit have seeds too large to be swallowed. Animals and birds may eat the fleshy parts and discard the hard seeds some distance away from where the fruit was plucked Some seeds and fruit have hooks, spines or stiff hairs which cling to the coat of passing animals or birds. They are called burr-fruit. Love grass and Urena are dispersed in this way.



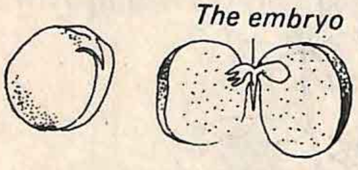
Dispersal by water

3. Dispersal by water : Plants like coconut, water lily and lotus are dispersed by water. The ripe coconut has a fibrous husk which has numerous air spaces. The air spaces enable the coconut to float, while the tough husk and shell protect the single seed inside from damage. Enclosed inside the shell is a supply of water. In this way the floating coconut can live for a long time and if cast on land, can germinate and grow into a new tree.
4. Dispersal by an explosive mechanism: The fruit of balsam, rubber and castor oil, when unripe, are green and juicy. When the fruit ripens, its walls become dry and hard. Within its walls pressures build up and at the slightest touch the dry fruit splits open and the seeds are thrown out with force.

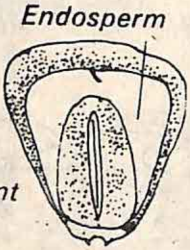
15393

Seed structure

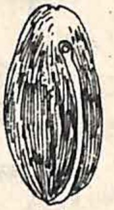
When you take a living seed in your hand, you are holding something which one day can grow into a big tree. If you open the seed carefully, you will find that within the protective covering there is a young plant with a small root and a small shoot. This young plant is called the embryo and the protective covering is called the seed coat. The small root of the embryo is called the radicle and its shoot is called the plumule. The seed leaves or cotyledons which are within the seed coat, are usually thick and contain food for the baby plant. Some seeds like peas and beans have two cotyledons. Seeds of plants like maize and corn have one cotyledon each. In these single cotyledon plants, food is obtained not from the cotyledon but from a tissue called the endosperm which surrounds the embryo.



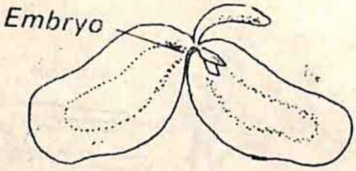
The embryo is a miniature plant which is immature



Seed with one cotyledon

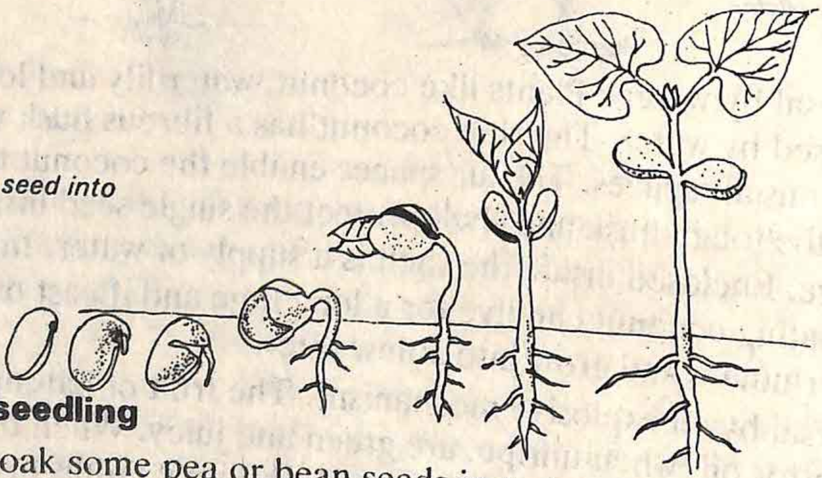


Seed coat



Seed with two cotyledons

Growth of a seed into a seedling



Seed to seedling

If you soak some pea or bean seeds in water and put them in a covered dish on moist blotting paper, you can watch them germinate. When the seed germinates you can observe three things happening.

1. At first the seed absorbs water into it and swells. You can see the difference in size in a pea seed before and after it is soaked in water. Because of this a moist soil is essential for germination.
2. A few hours or a day later the tiny root and shoot pierce the seed coat and grow.
3. You will observe that the tiny shoot grows upward and the root grows downward.

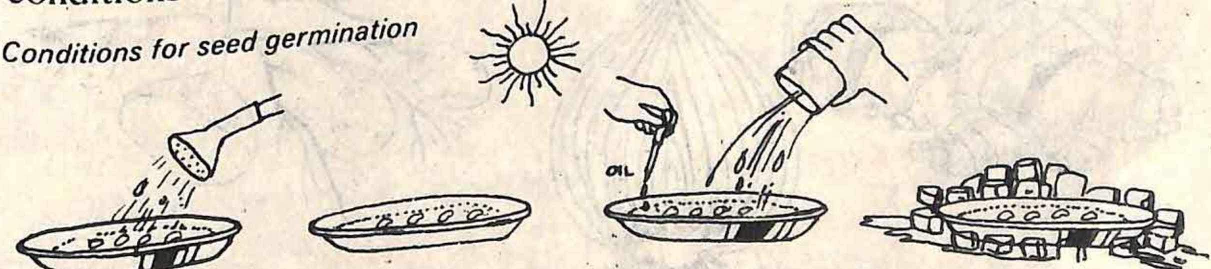
Conditions for seed germination

Seeds germinate only under certain conditions. Let us perform an experiment to find out what these conditions are. Take four saucers or dishes. Place cottonwool in all of them. Sprinkle a few mustard or green gram seeds on the cottonwool in each dish.

1. In the first dish, keep the cottonwool always moist. The seeds here get a good supply of water and air and are in the right (normal) temperature.
2. In the second dish, do not moisten the cottonwool. The seeds in this dish get air and the right temperature, but no water.
3. In the third dish, add water upto the brim of the dish. Pour a few drops of oil so that the water is covered by a layer of oil. Oil prevents the entry of air into the dish. So these seeds get water and the right temperature, but no air.
4. In the fourth dish, moisten the cottonwool and place the dish in a refrigerator or surround it with ice cubes. The seeds get water and air but not the right temperature.

Observe the growth of seeds in the four dishes. You will see that only the seeds in the first dish grow. Can you now say what are the conditions necessary for seed germination?

Conditions for seed germination



Water, air and normal temperature *No water* *No air* *Temperature not normal*

Why do seeds need these conditions?

Water: Water helps the seed in two ways. It softens and weakens the seed coat so that the shoot and root can penetrate it. It also helps to convert insoluble food stored in the seed into soluble food.

Air: Air is necessary for seeds to grow because it has oxygen. Oxygen is needed for respiration. The seed gets its oxygen from soil air. This is the main reason why the seeds are sown near the surface of the soil. Ploughing also aerates the soil.

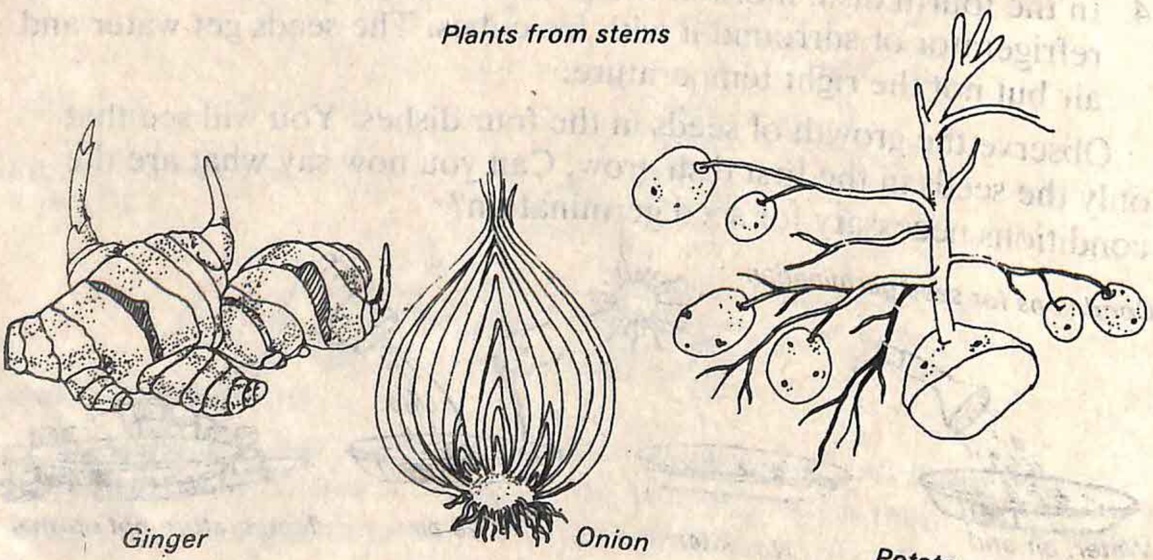
Temperature: Seeds do not germinate if it is very cold or very hot. This is because seeds become active only in suitable temperatures.

New plants from old plants

Some plants like roses, onions and potatoes do not reproduce with the help of seeds. In these and some other plants the stem, root or the leaves can give rise to new plants. This type of reproduction is called vegetative reproduction or propagation. This type of reproduction is much quicker than raising plants from seeds.

1. Plants from stems: Plants like mint and grasses produce new plants from their stems.

   Some stems grow beneath the soil. These underground stems may not be easy to recognise as such. Potato, onion, ginger and garlic plants are of this kind.

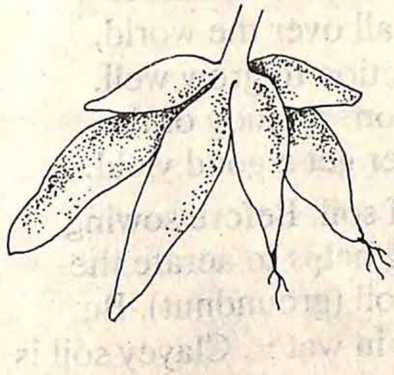


Plants from stems

Ginger *Onion* *Potato*

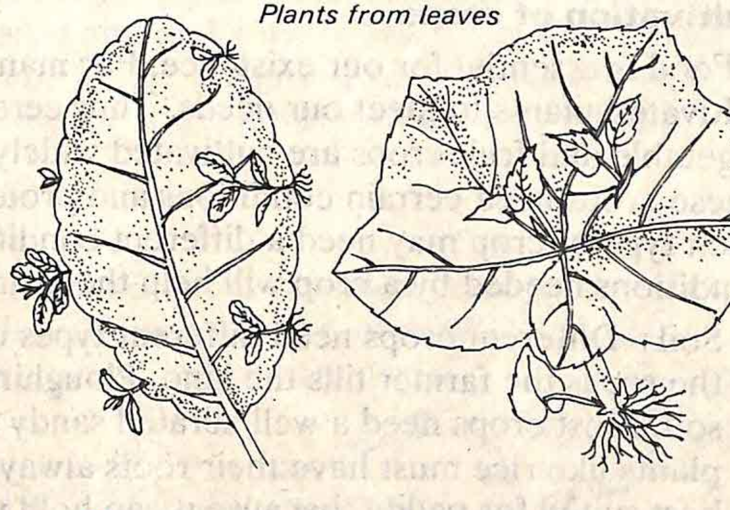
2. Plants from roots: Sweet potatoes are roots of plants. Roots and shoots grow from them.

Plant from roots



Sweet Potato

Plants from leaves



Bryophyllum

Begonia

3. Plants from leaves: Leaves of some plants when removed from the parent plant and kept in moist soil will produce new roots, stems and leaves. The bryophyllum and the begonia are examples of this.

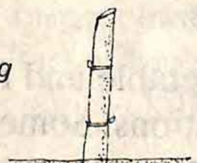
Gardeners make wide use of vegetative propagation for raising plants which give us flowers and fruit. Much time is saved and plants can be obtained in a shorter period. Also, plants will be exactly like the parent plant. Various ways have been used for getting new plants. The three main types are:

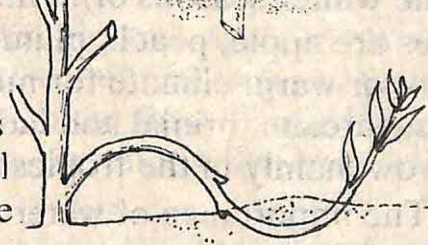
Cutting: Portion of stem detached and grown in moist soil (rose, bougainvillea, sugarcane).

Grafting: Cuttings attached to the shoots of another plant (mangoes, apples, roses).

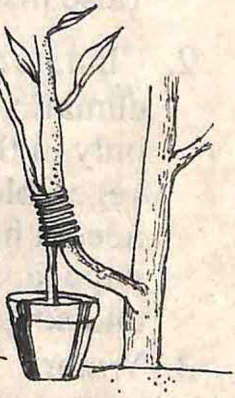
Layering: Branch of a plant is bent to make contact with the soil and a portion covered with it. The growing tip is exposed. After some

Cutting





Layering



Grafting

time roots develop. It is then cut and transplanted (jasmine and raspberries).

Cultivation of crops

Food is essential for our existence. For many years we have cultivated plants to meet our needs. Thus cereals, pulses, oilseeds, vegetable and fruit crops are cultivated widely all over the world. These crops need certain conditions and protection to grow well. Each type of crop may need a different condition. A study of the conditions needed by a crop will help the farmer get a good yield.

1. Soil: Different crops need different types of soil. Before sowing the seeds the farmer tills the land. Ploughing helps to aerate the soil. Most crops need a well-aerated sandy soil (groundnut). But plants like rice must have their roots always in water. Clayey soil is best suited for paddy because it can hold the maximum amount of water.

   The soil must be able to provide the nutrients required by the crop. The farmer can also add manure or chemical fertilisers to make the soil richer.

   Crop-rotation: If the same type of crop is grown year after year the soil becomes poor in a few minerals. So farmers usually grow some other type of crop, like peas or grams which use different minerals. Also, pulses make the soil rich in nitrogen. For this reason they do not need manure. This alternating of different types of crops is called crop-rotation. It helps the farmer to successfully raise his crops.

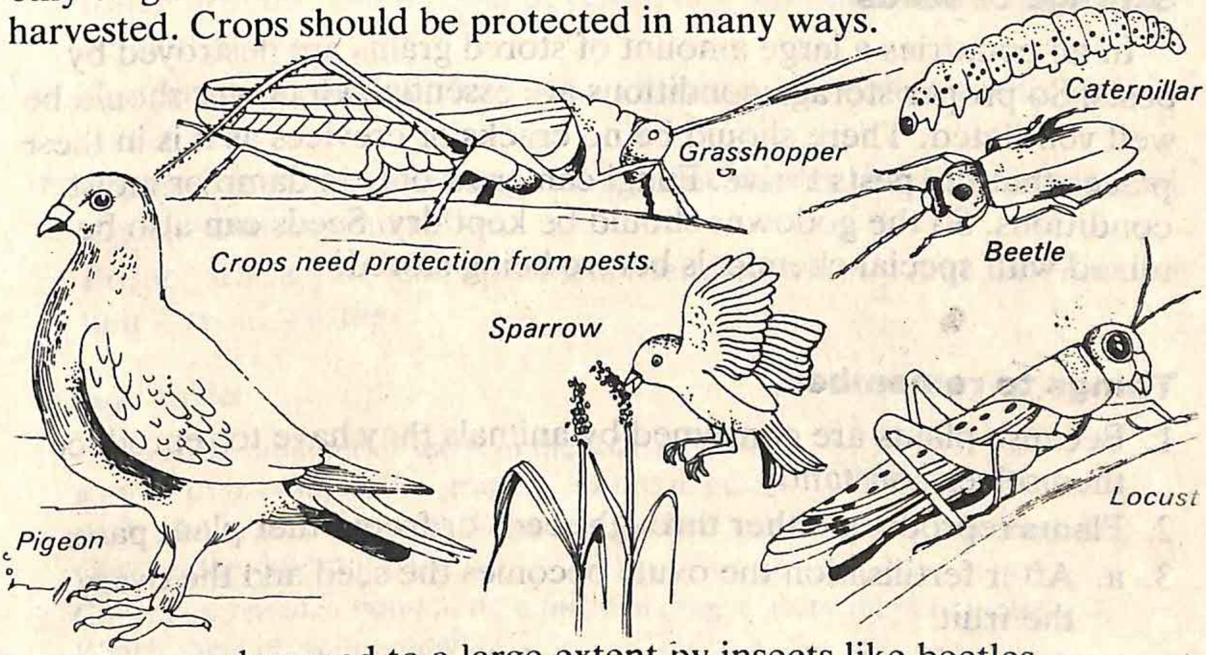
2. Climate: Vegetable and fruit crops grow only under certain climatic conditions. Some of them need a cool climate and grow only in the winter seasons or in hilly areas. Such fruit and vegetables are apple, peach, plum, cabbage and cauliflower. Others need a hot or warm climate for most of their lives. Banana, guava, papaya, sugarcane, brinjal and lady's finger need such a climate and so grow mainly in the tropics and sub-tropics.
3. Water: The importance of water to rice crops has already been mentioned. The seedlings are transplanted in water-logged fields

which have been flooded.

Other crops like groundnut, gram, cotton, jute, are grown in dry conditions with a moderate supply of water. They are successfully grown after a rainy season and make use of the water that remains stored in the soil. Tea and coffee are grown on hill slopes where the water is washed down leaving the soil wet, but not immersed in water.

Protection of crops

Providing the right conditions alone is not enough. A good yield can only be got if the farmer is able to protect his crop till it can be harvested. Crops should be protected in many ways.



Crops need protection from pests.

1. Crops are damaged to a large extent by insects like beetles, grasshoppers, locusts, mites and caterpillars. These may feed on leaves, fruit, corn or vegetables. Insects can be killed by spraying different types of chemicals.
2. Other pests are birds like parrots, pigeons, sparrows which feed on seeds, fruit and grams. Like birds, animals such as rats, mice and squirrels cause damage to crops in the field. They should be kept away from fields. Building a strong fence helps keep away larger animals like cows, buffaloes and goats.
3. Crop plants should be protected from diseases. These are caused

by viruses, bacteria and fungi. Diseases can be controlled by,

a. removing diseased plants from the field and burning them;
b. selecting seeds which are healthy and destroying unhealthy seeds with chemicals;
c. keeping the field clean by ploughing and using disinfecting chemicals;
d. by spraying chemicals to kill the pests..

Crop rotation also helps control disease. This is because the same type of pest often does not attack different types of plants.

Storage of seeds

In all countries a large amount of stored grains are destroyed by pests. So proper storage conditions are essential. Godowns should be well ventilated. There should be no cracks or crevices as it is in these places that the pests thrive. Fungi can grow only in damp or moist conditions. So the godowns should be kept dry. Seeds can also be mixed with special chemicals before being stored.

Things to remember

1. Because plants are consumed by animals they have to reproduce themselves constantly.
2. Plants reproduce either through seeds or from other plant parts.
3. a. After fertilisation the ovule becomes the seed and the ovary the fruit.
   b. A plant produces numerous seeds before it dies.
   c. Seeds are dispersed to distant places by various dispersal agents.
   d. The seed has a seed coat and an embryo.
   e. The embryo has an immature stem, a root and cotyledons.
   f. Two cotyledons are present in peas and beans.
   g. One cotyledon is present in maize and corn
   h. Cotyledons supply food.
   i. In maize and corn the endosperm supplies food.
   j. During germination the seed absorbs water and swells. The tiny

root and shoot pierce the coat and come out. The root grows down into the soil while the shoot grows above, towards light.

   k. Three things essential for germination are water, air and suitable temperature.

4. Vegetative reproduction is the process by which stem, root or leaves give rise to new plants. Potato, onion and ginger grow from underground stems. The sweet potato grows from its root. The bryophyllum is an example of a plant that grows from leaves.
5. Methods of raising plants through vegetative propagation are: a. cutting (detached portion of stem grown); b. grafting (the cuttings are attached to another rooted plant); c. layering (branch is bent to touch ground: when roots develop, new and old plants are separated).
6. Conditions important for crop cultivation are soil, climate and water.
7. Protection of crops is essential against insects, birds, animals, and disease-causing microbes.
8. Proper storage of seeds protects them from fungi and rodents and helps avoid wastage.

Things to do

1. Observe the number of seeds in the following fruit:
   a. mango; b. pumpkin; c. grape; d. bean; e. guava
2. Soak a bean seed in water. When it is swollen, gently open it on one side. Observe the different parts.
3. Collect an onion, a potato and a piece of ginger. Bury them in moist soil. Watch them grow into plants.
4. Get a bryophyllum leaf. Moisten it and hang it up with a piece of thread. Watch tiny roots grow from its sides.
5. Visit fields where vegetables, fruit or cereal crops are being grown. Observe the type of soil, climate and amount of water found in that area. Also note how the farmer protects his crops.

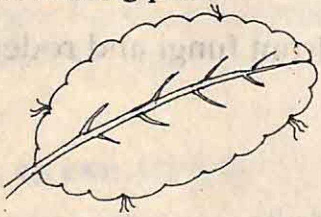
Exercises

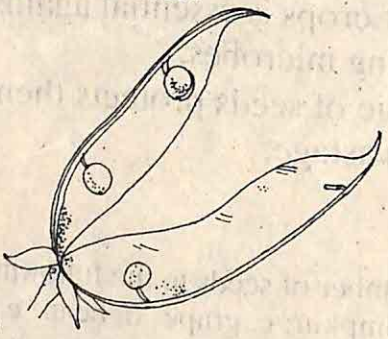
1. Answer briefly:
   a. In what way is the fruit helpful to the seed?
   b. Give an example of plants with two cotyledons.

c. What is an endosperm?
d. In which directions do the root and the shoot grow?
e. Why is oxygen necessary to seeds?
f. How does ploughing help germination?
g. Name one plant that reproduces through roots.
h. Name three ways in which plants are raised through vegetative propagation.
i. What are the different types of crops commonly cultivated?
j. Give one example of a plant that grows in sandy soil.
k. How can insect pests be killed?
l. Why should godowns be dry?

2. Answer in detail:
a. How do plants survive in spite of being constantly eaten up by animals?
b. Describe the structure of the seed.
c. How do water and air help in germination?
d. Describe ways in which stem and leaves give rise to new plants.
e. How does a gardener use cutting and grafting to raise new plants?
f. What is crop rotation? How does it help plants?
g. How can plants be protected from diseases?

3. Draw the missing parts:





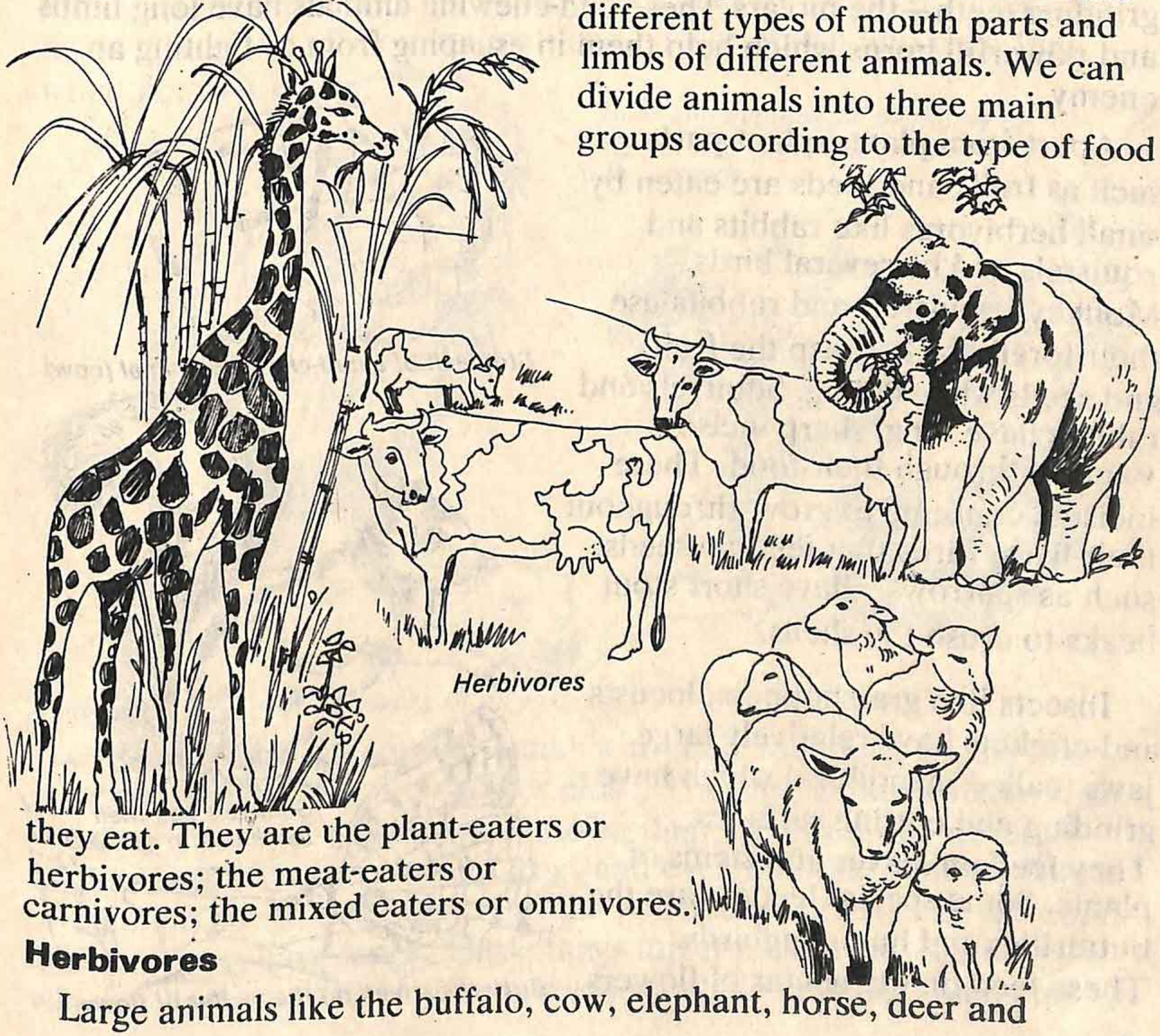
4. Tick the correct statements.
Correct those that are incorrect.
a. The fruit is not useful to the seed.
b. The seed of maize has two cotyledons.
c. The seed swells, because it absorbs water.
d. Vegetative reproduction is much quicker than reproduction through seeds.
e. Sugarcane grows in all climates.
f. Rats destroy large amounts of stored grain.

5. State which part of each plant helps in reproduction.
a. mango..........
b. bryophyllum..........
c. onion..........
d. sweet potato..........
e. rose..........

6. Draw a neat diagram of a bean seed and label the parts.

3. Feeding habits of animals

Green plants are producers. Animals are consumers. They may either feed directly on plants (primary consumers) or indirectly on plant-eating animals (secondary consumers). Animals show different adaptations to obtain their food. These adaptations are evident in the different types of mouth parts and limbs of different animals. We can divide animals into three main groups according to the type of food they eat. They are the plant-eaters or herbivores; the meat-eaters or carnivores; the mixed eaters or omnivores.



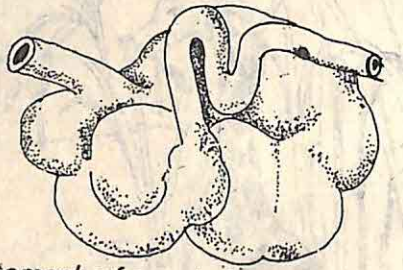
Herbivores

Herbivores

Large animals like the buffalo, cow, elephant, horse, deer and giraffe that feed on grass and leaves of trees are commonly called herbivores. Of these, the elephant and the giraffe are browsers that normally feed on the tender leaves of trees. Leaves normally out of reach to most animals are easily available to them because of the giraffe's long neck and the elephant's trunk. The tusks of the elephant help it to tear the barks of trees.

Cattle, goat and deer are grazers feeding on grass. They crop the grass with their sharp, knife-like incisor teeth. As the animals graze, the grass is immediately swallowed and stored in large special pouches in their stomach. Later, when they are resting, they bring the food (cud) back into their mouth and chew it well with the help of their powerful grinding teeth—the molars. These cud-chewing animals have long limbs and powerful horns which help them in escaping from or fighting an enemy.

Apart from plants, plant parts such as fruit and seeds are eaten by small herbivores like rabbits and squirrels and by several birds. Monkeys, squirrels and rabbits use their forelimbs to grasp the fruit and seeds while eating. Squirrels and rabbits have long, sharp incisors to gnaw through their food. These incisors continue to grow throughout their lives. Birds that feed on seeds, such as sparrows, have short stout beaks to crush the shells.



Stomach of a cud-chewing animal (cow)

Squirrels use their forelimbs to grasp fruit.

Insects like grasshoppers, locusts and crickets have relatively large jaws (called mandibles) which have grinding and cutting surfaces. They feed on leaves and stems of plants. Some special feeders are the butterflies and hummingbirds. These feed on the nectar of flowers.

Butterflies feed on the nectar of flowers.

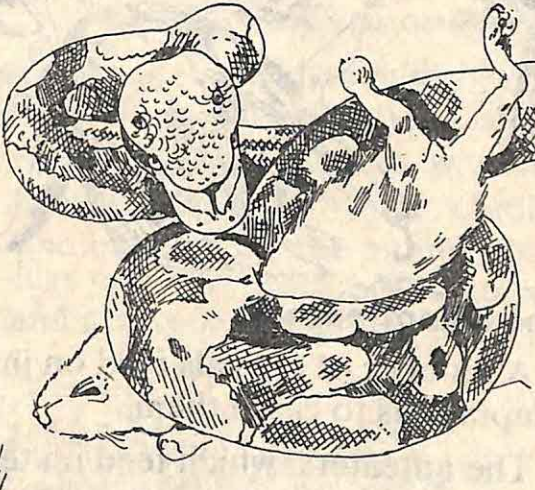
Butterflies get their nectar by means of long tubes called proboscis. These are normally kept coiled when not in use. Hummingbirds and sunbirds are the smallest of birds. They have long slender beaks which probe into flowers for nectar.

Carnivores

The cheetah, lion and tiger are typical carnivores. They are good hunters and have large sharp canines called fangs. These help in tearing the flesh of animals. Their cushioned feet make no noise when they move. When a carnivore (a tiger or lion) is very close to its unsuspecting prey, it springs on it or chases it in a speedy attack. It then quickly kills its victim (a deer or zebra) by biting its neck. The claws of these animals can be withdrawn into their feet when not in use

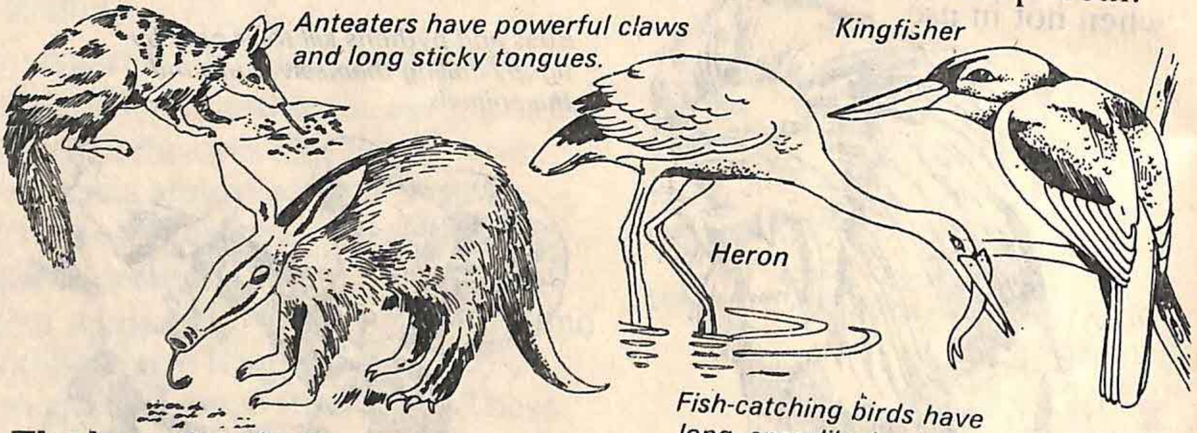
A lion uses its teeth and claws to kill its victim.

Boas and pythons kill their prey by tightly coiling themselves around the animals.



Crocodiles lie still on river banks with their wide long snouts open until an unsuspecting prey comes close. They are good swimmers and use their powerful tails to knock down their victims in the water. Snakes feed on mice, rats and frogs and even on other snakes. Many of them do not possess teeth. But the poisonous variety, like the cobra and the viper, have fangs. These fangs inject poison into their prey which kills them. All snakes can swallow whole animals which are larger than their heads. This is because their jaws are flexible and elastic and so their mouths can open very wide. Big pythons or boas can swallow a goat or a small deer very easily. These snakes are not poisonous but kill their prey by tightly coiling themselves around the animals so that they are unable to breathe.

Birds like owls, hawks and eagles have powerful sharp curved claws or talons. These talons are used to crush and carry away their prey. They have sharp curved beaks to tear their food. Vultures do not hunt but feed on dead animals. Fish-catching birds like the heron and the kingfisher have long spearlike beaks to catch fish. The spoonbill has a spoon-like beak to gather water insects, frog's spawn and shellfish in shallow waters. Some carnivorous fish like sharks and some whales snap up their food and tear them into tiny bits with their sharp teeth.



Anteaters have powerful claws and long sticky tongues.

Fish-catching birds have long, spearlike beaks.

The insect-eaters

A number of animals feed on insects and show some special adaptations to catch them.

The anteaters, which feed on termites and ants, have powerful claws to rip open the anthills. They then lick up the insects with long sticky tongues.

Some types of bats and birds like swifts and swallows catch insects while flying. They are small and can change direction very quickly. Woodpeckers have chisel beaks to make holes in trees and to dig out insects.

Frogs and chameleons have long sticky tongues which they flick out suddenly to catch insects quite a distance away. Spiders spin webs which are special traps for insects. The insects get caught in the web and are then eaten up by the spider.

Omnivores

A number of animals feed on both plants and animals. These omnivorous animals include rats, crows, bears and monkeys. The rat and crow feed on the flesh of other animals and also on any type of food eaten by man. Man himself feeds on grains, fruit, vegetables and on the meat of many animals. Bears are omnivores which feed on a variety of food like honey, fruit, insects, fish and roots.

Movement in animals

Movement is a distinctive feature of animals. Movement is essential for animals in order to get food and to escape from danger. The limbs of animals are modified for their ways of life. All structures that help in movement (limbs, fins, wings) are attached to powerful muscles.

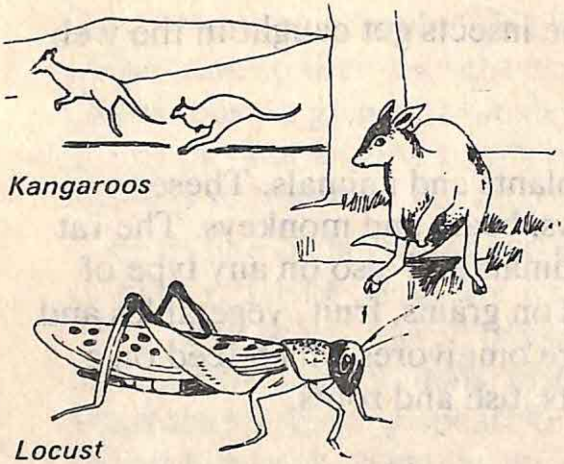
Fastmoving animals run on their toes.

Movement on land

Land animals have different types of limbs for running, walking, leaping, gliding, crawling, climbing and burrowing. The number of legs may vary from two (man, apes and birds) or four (animals like dogs, lions) to several (centipedes and millipedes).

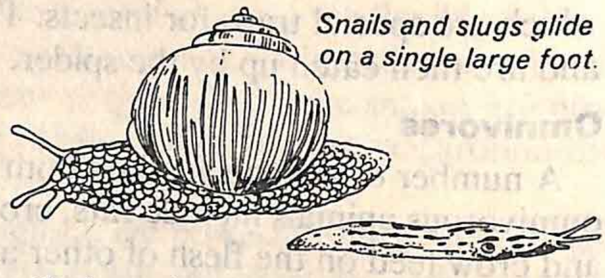
The runners (deer, gazelle, cheetah and ostrich) have long slender legs. These fast animals move on their toes. Some of them run on one toe (horse, rhinoceros) and some on two toes (sheep, cow, ostrich).

Some animals that walk most of the time (man and ape) walk with



Kangaroos

Locust



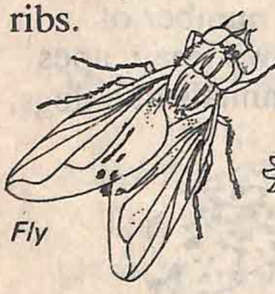
Snails and slugs glide on a single large foot.

their entire feet on the ground. Apes use all four limbs.

Kangaroos, frogs and locusts are good leapers. They have short fore limbs and long powerful hind legs with which they take great leaps. The kangaroo's tail also helps it to keep its balance.

Snails and slugs glide on a single large foot. They secrete a sticky fluid which helps in movement.

All insects possess three pairs of legs. Each has a pair of claws at the tip and sometimes a sticky pad. Lizards also have claws and adhesive pads on the undersurface of their limbs. Because of these, insects and lizards can crawl anywhere and can move easily, even upside down on ceilings. Snakes do not possess limbs but crawl with the help of scales on their undersurfaces which are attached to paired ribs.



Fly

Insects have six legs.

Lizard's limbs have adhesive pads.

Chameleons have prehensile tails.

A variety of animals live on trees. These are good climbers. Monkeys and apes have opposable thumbs (thumbs that can be brought in front of any of the other fingers). These help them to get a good grasp of the branches. Man, who is the most intelligent animal, uses his opposable thumb to handle tools efficiently. The monkey's tail coils around the branches to give it an anchorage. Such a tail is known as a prehensile tail. Prehensile tails are found in snakes which hang from branches, and in chameleons. The chameleon has toes with hooked claws to clamp around a branch.

Burrowing animals like rats, shrews, moles have powerful limbs, with claws for digging.

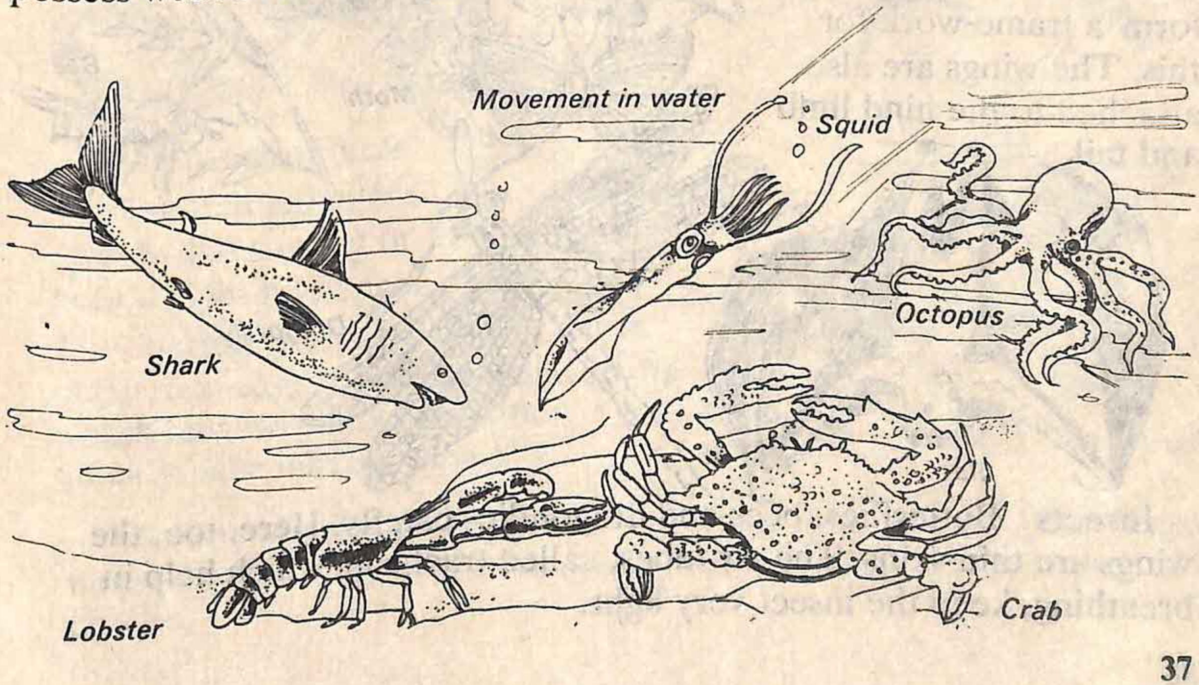
Movement in water

Animals which live in water and are good swimmers have streamlined bodies and are propelled through water by their tails.

The dorsal, ventral and side fins of fish help in balancing and steering. The tail fins move from side to side to push the animal forward. Fish are good swimmers because of their streamlined bodies.

Mammals that live in water have adapted themselves to their environment. Dolphins, whales and porpoises have streamlined bodies too. Their front limbs are modified into fin-like structures called flippers. These are used in balancing and turning. The tail in these animals pushes the body forwards with its up and down movements.

Many animals that move on land are also good swimmers. Frogs, otters, turtles and many water-birds like ducks, pelicans and seagulls possess webbed feet. Alligators and crocodiles have short limbs used



as paddles. They use their powerful tails for swimming. All snakes swim easily in water because of their long and slender bodies. Sea snakes have flattened oar-like tails.

Some other animals that are not streamlined and do not possess fins or webbed feet, still live successfully in water. Crabs and lobsters use their legs to crawl on the sea bed. Squids, octopuses and cuttlefish move by "jet propulsion". They take in water into large body cavities and expel them through a narrow nozzle with great force.

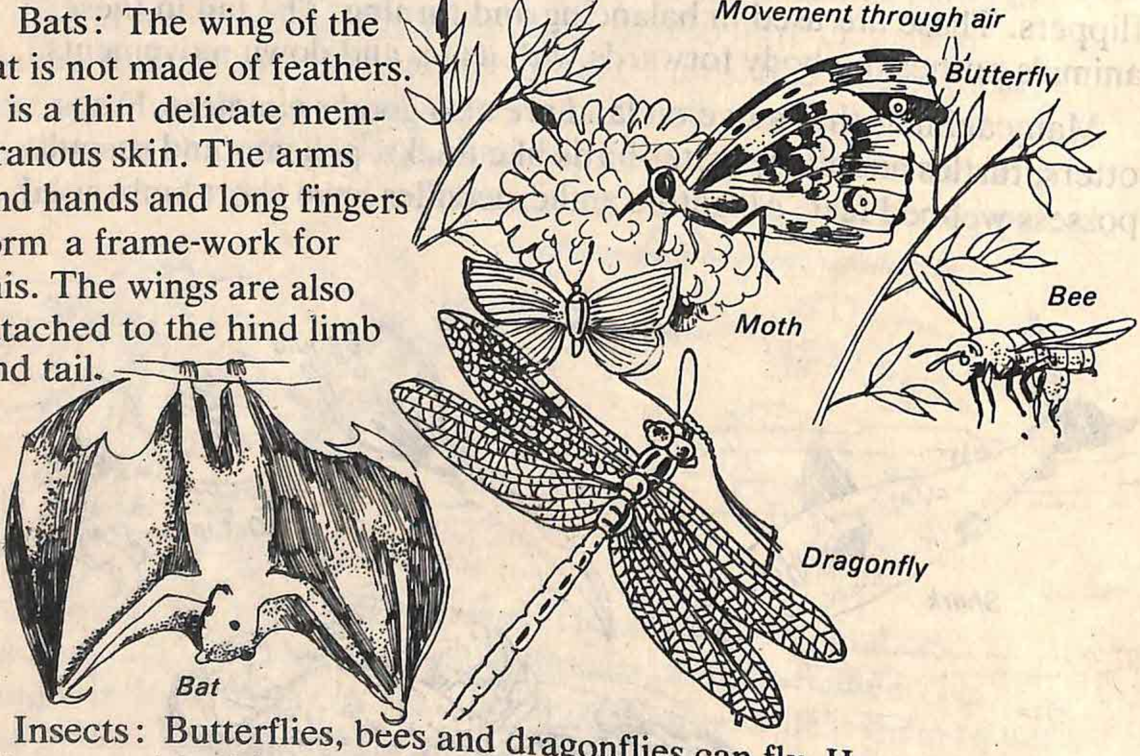
If water is expelled backwards with force, the animal is pushed forward with the same force.

Jellyfish and plankton depend entirely on water currents. They remain floating on the water surface.

Movement through air

Most birds, bats and some insects have wings which enable them to fly. These provide a large surface area.

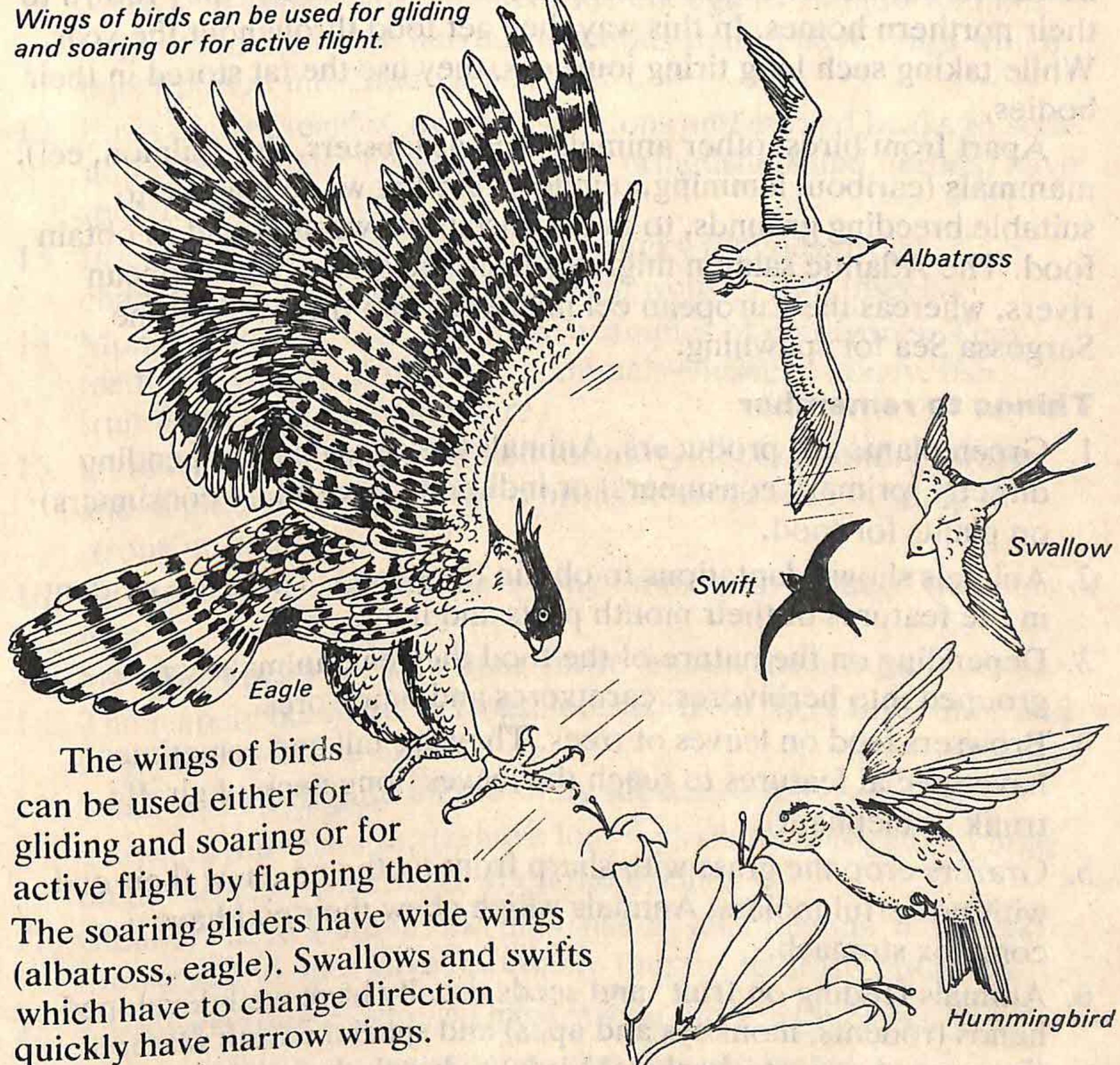
Bats: The wing of the bat is not made of feathers. It is a thin delicate membranous skin. The arms and hands and long fingers form a frame-work for this. The wings are also attached to the hind limb and tail.


Movement through air

Insects: Butterflies, bees and dragonflies can fly. Here, too, the wings are thin skins. The air tubes, called tracheae, which help in breathing, keep the insect very light.

Birds: The wings of birds are made of feathers, and so are light and airtight. They are attached to powerful muscles of the chest. The bones of the birds are strong and light. The bones have air spaces which make the whole body of the bird very light. The legs of birds are drawn towards the body when they are flying. When they land on a branch they extend their legs to grasp the branch.

Wings of birds can be used for gliding and soaring or for active flight.



The wings of birds can be used either for gliding and soaring or for active flight by flapping them. The soaring gliders have wide wings (albatross, eagle). Swallows and swifts which have to change direction quickly have narrow wings.

The tiny hummingbirds have small wings that beat very fast. These help them to hover (like helicopters) while feeding on the nectar of flowers.

Bird migration

Many birds travel regularly to other lands from their homes. This is called migration. Being able to fly, they usually go to distant lands. The arctic tern migrates from the Arctic regions to the Antarctic! Most other birds travel shorter distances. They may either fly singly or travel in flocks. Usually birds travel from their colder northern homes to warmer southern homes in winter. In summer they return to their northern homes. In this way they get food throughout the year. While taking such long tiring journeys, they use the fat stored in their bodies.

Apart from birds, other animals such as lobsters, fish (salmon, eel), mammals (caribou, lemming, reindeer) are known to migrate to suitable breeding grounds, to avoid unsuitable weather and to obtain food. The Atlantic salmon migrates from the sea to the European rivers, whereas the European eel migrates from the rivers to the Sargossa Sea for spawning.

Things to remember

1. Green plants are producers. Animals are consumers depending directly (primary consumers) or indirectly (secondary consumers) on plants for food.
2. Animals show adaptations to obtain their food. These are evident in the features of their mouth parts and limbs.
3. Depending on the nature of the food they eat, animals can be grouped into herbivores, carnivores and omnivores.
4. Browsers feed on leaves of trees. They are tall and sometimes have special features to reach the leaves (long neck of giraffe, trunk of elephant).
5. Grazers crop the grass with sharp front teeth and chew their cud with powerful molars. Animals which chew their cud have a complex stomach.
6. Animals feeding on fruit and seeds usually have well-developed hands (rodents, monkeys and apes) and special mouth features (incisors of rodents, beaks of birds) to break the seeds.
7. Insects have mandibles for cutting and grinding plant parts.
8. Hummingbirds have long slender beaks. Butterflies have

proboscis to probe flowers for nectar.

9. Cats, dogs, lions and tigers have well-developed canine teeth to tear the flesh of animals. They have powerful limbs with padded feet and claws.
10. Crocodiles trap victims with wide open jaws. Their tails are strong weapons.
11. Snakes can open their mouths wide enough to swallow animals larger than their own heads. Poisonous snakes have fangs which inject poison into their victims.
12. Birds of prey (eagles, owls) have talons and curved beaks to seize and tear animals. Fish-eating birds (kingfishers and herons) have spearlike beaks.
13. Insect-catching animals have long sticky tongues (frogs, chameleons, anteaters). Spiders spin webs to trap insects.
14. Monkeys, rats, crows, bears are examples of omnivores. They feed on a variety of plants and animals—insects, honey, fish, fruit. Man is also an omnivore.
15. Limbs of animals are modified for movement on land, in water and in air. Their movement is brought about with the help of strong muscles.
16. Runners (deer, cheetah) have long limbs with reduced numbers of toes.
17. Men and apes walk with their entire feet on the ground.
18. The leapers (kangaroos, frogs, locusts) have short fore limbs and long powerful hind limbs.
19. Snails and slugs glide on the slimy substance they secrete.
20. Crawlers (insects, lizards) have legs with claws and pads to hold on to surfaces. Snakes crawl on their scales.
21. Climbers have a prehensile tail (snakes, chameleons, monkeys). Monkeys and apes have opposable thumbs to grasp branches.
22. Burrowers (moles, shrews) have strong limbs with claws.
23. A streamlined body helps in moving through water.
24. Fins (fish) and flippers (whales, dolphins) help in balancing and steering.

25. The side to side (fish, crocodiles) or up and down (whales, porpoises) movements of the tail propel the animal forwards.
26. Webbed feet of frogs and otters and flippers of turtles help these animals to move in water.
27. Squid, octopus and cuttlefish move by expelling water in jets through narrow openings.
28. The bat's wing made up of skin is spread between its limbs to which it is attached.
29. Insects have wings made of thin, stretched skins.
30. a. Birds' wings are made up of feathers. Wings are moved by powerful chest muscles.
    b. Bones are hollow to make the body light.
    c. Shape of wings varies for birds that glide, soar, or those that fly quickly.
    d. Legs of birds are adapted for perching.
31. Many birds migrate every year to distant lands. They travel from colder regions to warmer lands in search of food. During these journeys they use fat stored in their bodies.
32. Lobsters, fish and certain mammals (lemming, caribou, reindeer) also migrate.

Things to do

1. Keep a lookout for the following animals, observe how they feed and make notes from your observations:
   a. butterfly; b. cow; c. squirrel; d. sparrow; e. frog; f. lizard; g. eagle or owl; h. kingfisher; i. woodpecker; j. spider.
2. Observe the legs of the following animals at rest and in movement:
   a. millipede; b. cow or horse; c. frog; d. locust; e. snail; f. lizard; g. monkey; h. chameleon.
3. Visit an aquarium. Observe the movement of fishes and other animals in water.
4. Collect wings of insects and feathers of birds. Paste them in your scrapbook.
5. When you see birds flying in flocks, note the patterns they make ('V' or 'W') when they fly. Try to identify birds in flight.
6. Collect pictures of animals feeding or in movement and paste them in your scrapbook.

Exercises

1. Answer briefly:
   a. Give two examples of browsers.
   b. Give two examples of grazers.
   c. What type of teeth do dogs have?
   d. Which of the squirrel's teeth help in gnawing?
   e. What are mandibles?
   f. What is a proboscis?
   g. How does the fang help a snake?
   h. Which type of bird has a spearlike beak?
   i. Give one example of an omnivore.
   j. How is the tail of a kangaroo useful to it?
   k. How do snails move?
   l. What is an opposable thumb?
   m. Name two animals that have webbed feet.
   n. What type of wing does the albatross have?
   o. How do the wings of bats and insects differ from the wings of a bird?

2. Answer in detail:
   a. What is migration? Why do birds migrate?
   b. How do fish swim in water?
   c. How are some animals adapted for climbing?
   d. In what way do anteaters and frogs obtain the insects they eat?
   e. How is nectar obtained by bees and hummingbirds?
   f. How do cud-chewing animals feed?

3. Fill in the blanks:
   a. Squirrels and rabbits have .... to gnaw.
   b. The cheetah moves silently because it has .... feet.
   c. The jaws of snakes are .... and ....
   d. Birds are light because their bones are ....
   e. Good leapers have .... fore-limbs and .... hind-limbs.
   f. Lizards have .... and .... on their feet.
   g. Shrews and moles are .... animals.
   h. A bird that feeds on nectar is a ....

4. What helps these animals to move?
   a. chameleon ....
   b. horse ....
   c. snake ....
   d. dolphin ....
   e. bat ....
   f. turtle ....
   g. octopus ....

5. Match the animals with their food.

   a. cricket
   b. elephant
   c. crocodile
   d. squirrel
   e. snake
   f. kingfisher
   g. anteater

   termites and ants
   fish, birds and animals
   tender bamboo shoots, leaves, coconuts
   stems and leaves of plants
   fish
   nuts, seeds and fruit
   other snakes, rats and frogs

6. Draw neat figures of
   the limbs of a horse, a duck, a whale, a lizard.

UNIT IV *AIR, WATER AND WEATHER*

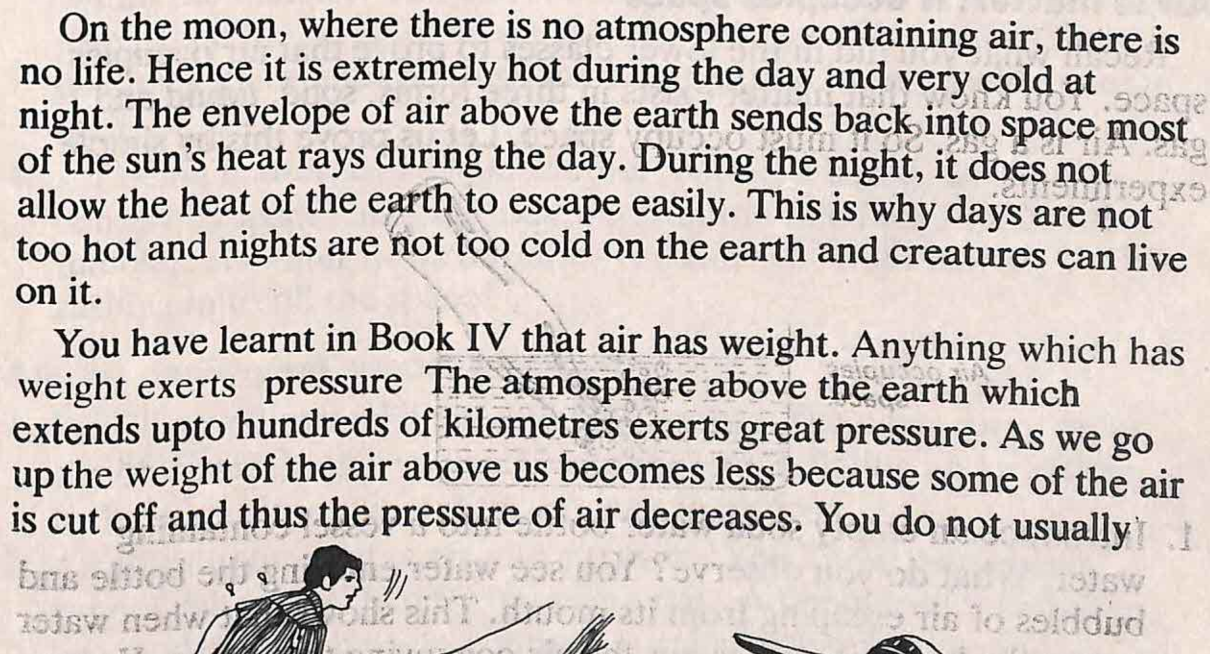
4. Properties of air

An invisible ocean

The earth is the only planet in our solar system which supports life. One-fourth of the earth is land and the rest is covered with water–oceans, lakes and rivers. Above the surface of the earth, upto hundreds of kilometres, there is air. We live at the bottom of this great ocean of air called the atmosphere. Animals live both on land and in water. The water in the oceans and lakes contains air dissolved in it. The sea creatures, both plants and animals, make use of this dissolved air for breathing.

On the moon, where there is no atmosphere containing air, there is no life. Hence it is extremely hot during the day and very cold at night. The envelope of air above the earth sends back into space most of the sun's heat rays during the day. During the night, it does not allow the heat of the earth to escape easily. This is why days are not too hot and nights are not too cold on the earth and creatures can live on it.

You have learnt in Book IV that air has weight. Anything which has weight exerts pressure The atmosphere above the earth which extends upto hundreds of kilometres exerts great pressure. As we go up the weight of the air above us becomes less because some of the air is cut off and thus the pressure of air decreases. You do not usually



When you climb mountains or fly high in an aeroplane, your blood pressure is higher than the atmospheric pressure.

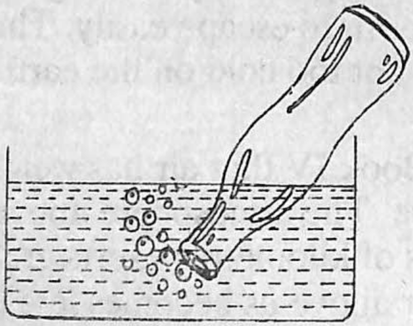
feel this atmospheric pressure because your blood exerts pressure which more or less balances the atmospheric pressure. Your blood pressure is actually slightly more than the atmospheric pressure on the ground. But if you climb high mountains or fly high in an aeroplane your nose and ears are likely to bleed because higher blood pressure forces the blood outwards.To avoid this modern aircraft are pressurized at normal ground level pressures. Do you understand why astronauts wear pressurized suits? You would have seen pictures of Neil Armstrong wearing a suit when landing on the moon.

Man explores this invisible ocean

Man has explored this invisible ocean of air to the best of his ability. He is now able to fly aeroplanes which travel at great speed. He is sending rockets and weather satellites out into space to explore the changing air pressure and climatic conditions to help him foretell rain, snowfall and storm. He is using air pressure and the force of the wind to work many machines which he has invented.

Air is matter: it occupies space

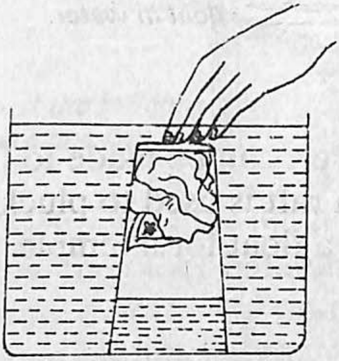
Recall what you did in the lower classes to prove that air occupies space. You know that matter exists in three forms, solid, liquid and gas. Air is a gas. So it must occupy space. Let us prove this by simple experiments.

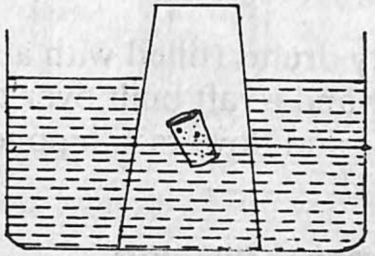


Air occupies space.

1. Introduce an empty soda water bottle into a vessel containing water. What do you observe? You see water entering the bottle and bubbles of air escaping from its mouth. This shows that when water enters the bottle it pushes out the air occupying that space. Hence we can say that the bottle is not really empty but is filled with air.
2. Place a kerchief in a glass tumbler as shown in the figure. Invert it into a basin of water and push it down so that the tumbler gets

completely immersed in water. Then lift the tumbler up slowly and take the kerchief out. The kerchief remains dry! This is because air that filled the space within the tumbler surrounded the kerchief, preventing the water from wetting it! This shows that the empty tumbler contained air.


The kerchief remains dry.

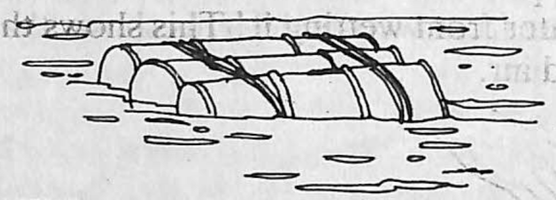

The cork floats at a lower level.

3. Float a cork in a basin of water. Invert a glass tumbler over it and press it in. The cork still floats in water. But note the level of water within the tumbler. You can see that the cork floats at a level much lower than the level found outside the tumbler. This proves that air occupies space and can push the water a little lower, exerting force on it!
4. Air being matter, can displace other matter, a liquid, and can occupy its space. Invert a soda water bottle filled with water into a tumbler. As water flows out of it, you can see bubbles of air rushing in to fill the space!

Air, by occupying space, helps us

1. We fill air-pillows with air, and they become flat when air escapes out of them. Do this yourself, inflating and deflating an air pillow by blowing air into it and then releasing air from it.
2. Air fills the tubes of cycle and car tyres. You know that wheels cannot roll smoothly if the tyres are flat. A punctured tube has to be mended if we have to continue our journey smoothly and comfortably.
3. A football can bounce well only if its bladder is filled with air.
4. A lifebuoy or float, filled with air, tied to the back of a beginner,

helps him to float in water before he learns to swim.



Empty drums tied together float in water.

5. Empty drums (filled with air) tied together, can be made to float in water and a raft built over them! Such a raft is used to pluck lotus leaves and flowers in a pond or to build a float for a temple festival.

Air supports burning

Air contains a gas called oxygen which helps things to burn in it. It is also useful for breathing.

Compressed air

When air is pumped into cycle or car tyres, they support the weight of the vehicle and the rider and roll smoothly on the road. Air inside the tube is compressed or put under pressure to enable it to do work.

A football gets a proper bounce only when air is pumped into the bladder to inflate it completely. Here also compressed air fills the bladder to give the football its bounce.

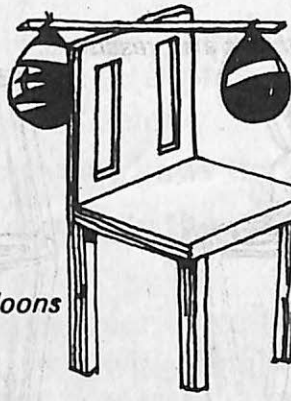
Air has weight

Now that you have proved that air is matter and can occupy space, you can understand that it must have weight. Any matter, light or heavy, has weight.

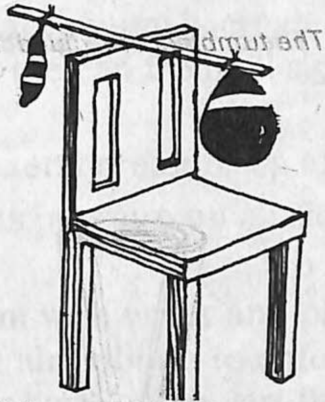
Recall the balloon experiment you did in a lower class.

Take a straight metal rod or a scale. Balance the rod or scale on the back of a chair as shown in the figure. Then inflate two balloons to an equal size. Tie them one each on either side of the scale (or rod). Adjust them in such a way that the scale does not tilt towards one side but remains horizontal.

Now take a sharp needle and prick one of the balloons near its neck.



Prick one of the balloons with a sharp needle.



The balloon with air in it is heavier.

(Do this without allowing it to burst.) Air escapes through the pin hole. Now the other balloon slowly brings the scale down at its end. This shows that the balloon with air in it is heavier. This experiment proves that air has weight.

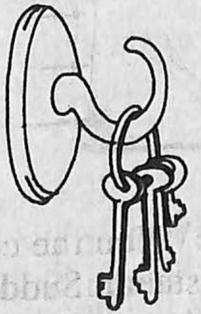
Air exerts pressure

Anything that has weight must exert pressure. Air has weight. So air exerts pressure. Air can be compressed. Compressed air exerts more pressure than ordinary air.

Experimenting with air pressure

1. Have you made use of rubber suckers to hang keys? What makes the sucker adhere to the wall or the glass pane of a car? How does it bear the weight of the keys?

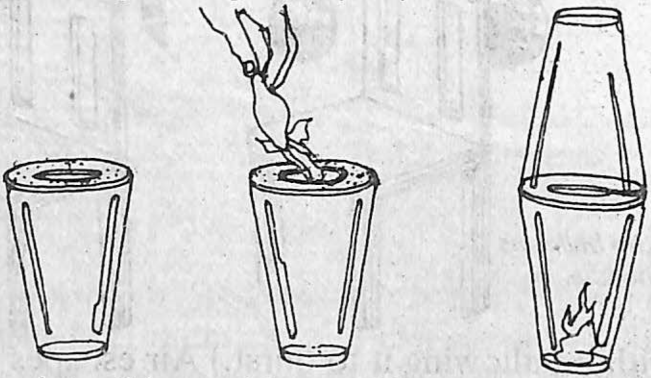
   Take a flat rubber sucker and attach it to a window pane or a wall. Now try to pull it out, holding its hook tight. You find it difficult to do so. This is because air exerts pressure on all sides. and presses it tight on the glass pane or wall. When the sucker is attached to the wall, a partial vacuum is created between the sucker and the wall. So air pressure from outside holds it tight.



What makes the rubber sucker adhere to the wall?

2. You can glue two tumblers together. Take two glass tumblers of equal size and smooth rim (edge of the mouth). Cut a blotting paper ring or collar to the size of the rim, as shown in the figure. Wet this and place it on the rim of a tumbler. Quickly drop a piece

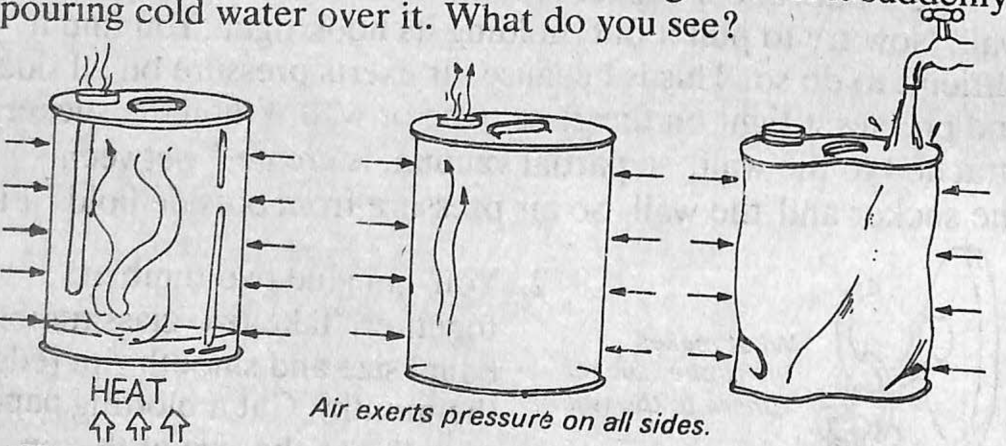
The tumblers are 'glued' together by air pressure.



of burning paper into this tumbler and invert the other one over this so that the two rims fit exactly one over the other. After the paper stops burning, try to pull the tumblers apart. This will be difficult as they are both 'glued' together by air pressure.

The burning paper uses up oxygen in the air from within the tumblers. Therefore the space occupied by the oxygen is now empty. Thus a partial vacuum is created within the tumblers. This enables air outside to exert pressure on their rims to hold them tight. The wet blotting paper ring or collar acts as a seal and prevents air from entering the tumblers.

3. Take an empty tin can with a tight-fitting lid. Remove the lid and pour a little water into it. Heat the tin can over a stove. Allow steam to escape. Now close the tin can tight. Cool it suddenly by pouring cold water over it. What do you see?



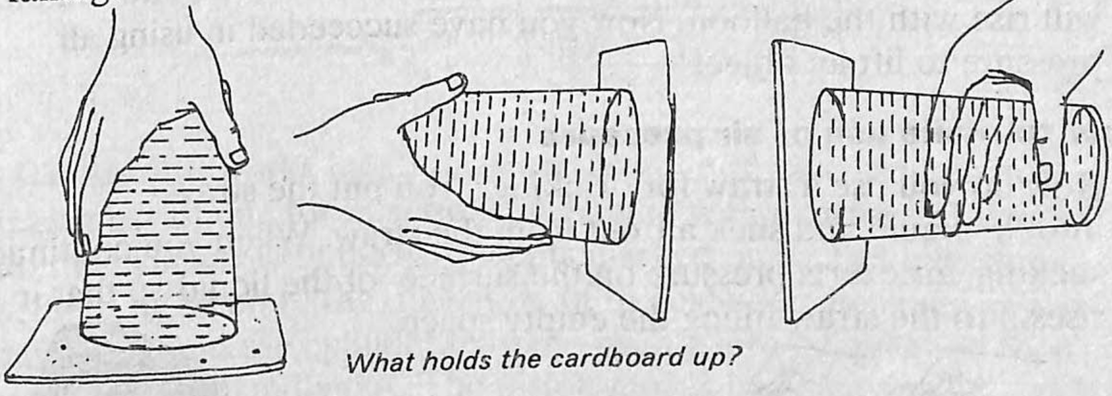
Air exerts pressure on all sides.

The lid is jammed and the can gets out of shape. When the can with water is heated, the air in it is driven away by steam. Sudden cooling condenses the steam to water. This leaves the space within the can partially empty and a partial vacuum is created. Now the atmospheric air exerts pressure on the can from all sides to crush the tin can out of shape.

This experiment shows that air exerts pressure on all sides.

4. You can demonstrate that air exerts pressure on all sides in yet another way.

Fill a glass tumbler upto the brim with water and place a thin cardboard over it without allowing air bubbles to enter into it. Hold the cardboard tight with your hand and invert the tumbler. Next remove your hand. The cardboard will not not fall down. How can it bear the weight of water within the tumbler? What holds it up? It is the air pressure that keeps the cardboard from falling.



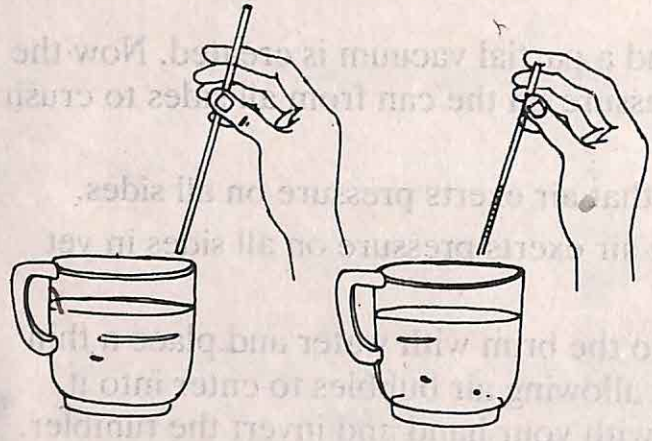
What holds the cardboard up?

How can you show that air exerts pressure on all sides?

Hold the cardboard tight once again and tilt the tumbler to one side as shown in the figure. What do you see? The cardboard stays in place. Turn the tumbler over to the other side carefully. The cardboard will not fall down.

5. Dip a straw or a glass tube into a cup of water and then pull it out. What do you see? There is no water in the tube.

Now dip it once again in water and place your fore-finger over the opening and hold it tight. Now lift up the tube again. What do you see? There is water in the tube. This is because air pressure acts on the surface of the water at the lower end of the tube, keeping it within the tube. When you remove your finger, water



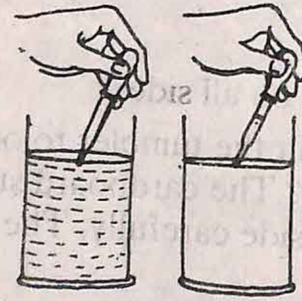
Water stays in the straw if you close it with a finger.

flows out of the tube as air pressure, acting downward from above, balances the pressure acting upward from below. And so, because of its own weight water flows down.

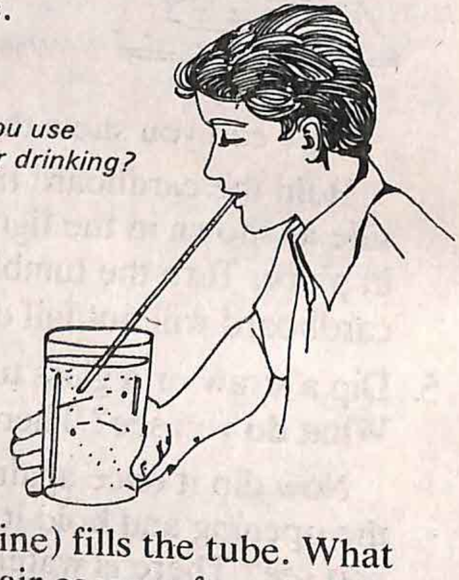
6. Can you lift a cup or a tumbler using air pressure? Keep a balloon inside a cup or a tumbler and blow air into it until it inflates enough to catch the rim of the vessel. Tie it and lift it. The tumbler will rise with the balloon. Now you have succeeded in using air pressure to lift an object!

How to make use of air pressure

1. How do you use a straw for drinking? You put the straw into the liquid and suck air out from the straw. When you continue sucking, air exerts pressure on the surface of the liquid so that it rises into the straw filling the empty space.



How does an ink filler work?

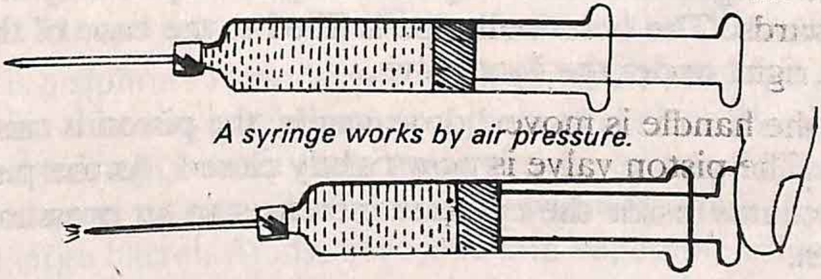


How do you use a straw for drinking?

2. Take an ink filler or a medicine dropper. Dip it in a liquid. Press the rubber bulb. What do you see? Bubbles of air escape. Now release the bulb. The liquid (ink or medicine) fills the tube. What happens actually? As the bulb is pressed, air escapes from it. When the bulb is released, a partial vacuum is created inside the filler.

The air pressure which is exerted on the surface of the liquid pushes the ink into the filler or the medicine into the medicine dropper.

3. The same thing happens in the case of a fountain pen with a self-filler. It is provided with a rubber tube attached to its neck and nib. When the pen is dipped in ink and the tube pressed, the air escapes. When the tube is released, ink rushes in to fill the tube as air exerts pressure on the surface of the ink in the bottle.



A syringe works by air pressure.

4. A syringe also works by air pressure. You must have seen doctors making use of one for injections. A handle with a piston fits tightly into the cylinder with measurements marked on it. The injection needle is fitted on to the other side of the cylinder. Push the piston completely into the cylinder. Dip the needle into a liquid and then slowly pull the handle out. The piston moves back leaving a vacuum within the cylinder. Now the air pressure exerted on the surface of the liquid pushes it into the needle of the syringe. Instead of an ordinary liquid, the doctor uses medicine. When he injects medicine into your body, he pushes the handle and piston into the cylinder so that the medicine can get into your blood stream.

5. Take a wash bottle filled with water and fit it with a two-holed stopper. Fit a short, bent delivery tube through one hole and a long tube with a spout into the other. When you blow air into the shorter tube, water comes out through the long tube with a spout like a fountain! How does this happen?

The air you blow in exerts pressure on the surface of the water and makes it rise up into the tube with great force. Hence a fountain is formed.

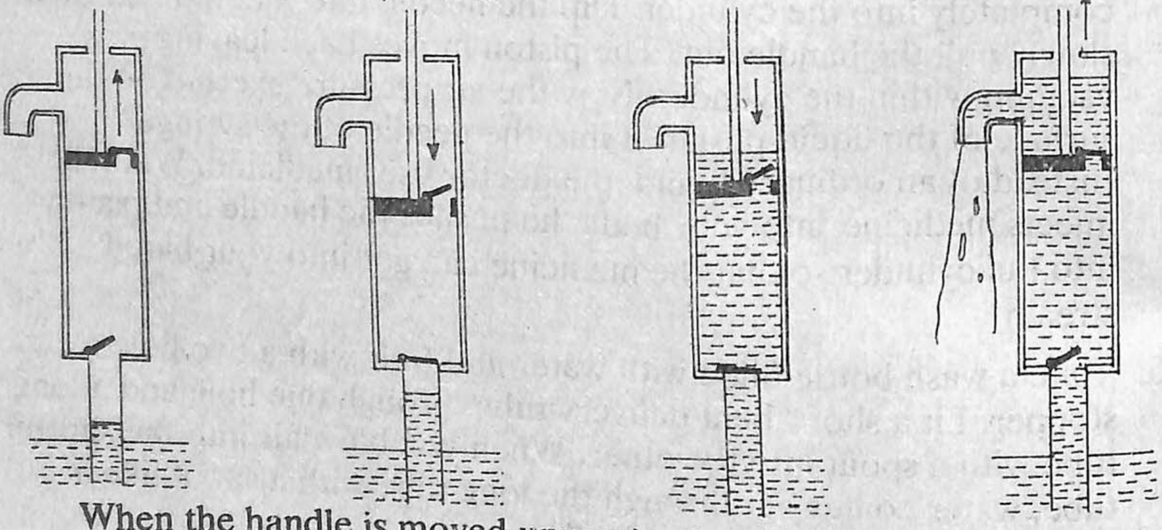
6. How does a lift pump use air pressure? The lift pump works on the principle of a syringe. We usually fit it to a bore-well to pump out groundwater. It is provided with a cylinder with a tight-fitting piston. This in turn is attached to a handle.

   The lift pump has two valves. One is the foot valve, found at the foot of the cylinder and the other is the piston valve. Both the valves are hinged in such a way that they can open only to one side, upwards. The bore-well pipe is filled to the base of the cylinder, right under the foot-valve.

   When the handle is moved downwards, the piston is raised upwards. The piston valve is now tightly closed. As the piston goes up, the volume inside the cylinder increases so air pressure decreases.

   Decrease in air pressure within the cylinder enables air pressure to act on the surface of the water. So water from the water table rises into the bore-well and enters the cylinder pushing the foot valve up.

The lift pump also works by air pressure.



   When the handle is moved upwards, the piston moves downwards. Now water in the cylinder exerts pressure on the foot valve and closes it tight. So the water cannot flow back into the tube of the bore-well. The pressure of water exerted on the piston valve opens it outwards. So water from the cylinder rises up and occupies the space above the piston in the cylinder.

When the handle is once again moved downwards, the piston goes upwards. So the water above it comes out through the spout and the pressure decreases within the cylinder. At the same time, the foot valve opens and more water rushes in from the tube to normalise the pressure.

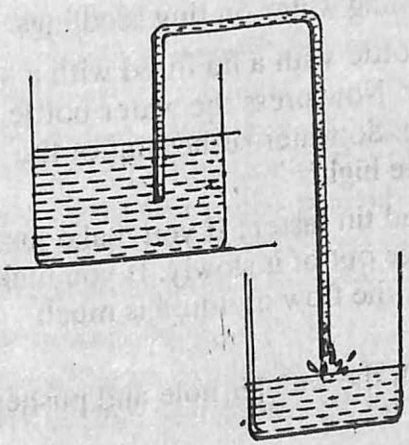
The movement of the handle upwards and downwards is repeated to get a continuous flow of water from the spout.

7. What is a siphon? How does it work using air pressure?

A siphon tube made of glass, or a plain rubber or plastic tube, can be used to empty water from an aquarium or transfer a liquid from a large barrel into smaller containers without tilting the aquarium or the large barrel. Acids, kerosene and vegetable oil are usually transferred in this way.

A siphon works using air pressure. A long rubber or plastic tube is filled with the liquid which has to be transferred from a larger vessel into a smaller one, without allowing any air bubbles within the tube. Close the tube at either end with the thumbs of your hand. Now dip one end of the tube into the larger vessel and lower the other end into the smaller one. Keep the larger vessel at a higher level than the smaller one. Now release both thumbs. There is a steady flow of liquid from the higher to the lower level through the siphon tube.

Air pressure acts on the surface of the liquid at a higher level and pushes it down to the lower level. So the liquid is sent into the siphon tube at a steady rate. The flow will stop if the levels in both the vessels become equal as the air pressure at a particular height is the same.



Air pressure pushes liquid from a higher to a lower level.

Things to remember

1. We live under an invisible ocean of air.
2. Man uses the force of the wind and air pressure to his advantage.
3. Air is matter and so it occupies space.
4. Air fills balloons, tyre tubes, football bladders and lifebuoys.
5. Air has weight. Because air is matter, it must have weight.
6. Anything that has weight exerts pressure. So air also exerts pressure.
7. Compressed air is subjected to great pressure.
8. We can make use of air pressure in filling a medicine dropper, a syringe and a self-filling fountain pen. It enables us to suck liquid using a straw. We can make a fountain using air pressure. We can lift water from the water-table using a lift pump. A siphon tube also works using air pressure.
9. Air pressure varies according to depth or height
10. Liquids are transferred from a higher level to a lower level due to difference in air pressure.

Things to do

1. A water-sprinkler: You can make this using the principle of a drinking straw. Take a tin with a flexible plastic lid. Make tiny holes in its bottom like the holes of a water-sprinkler. Make a hole in the lid also.

   Now pour water into the tin and close it with the lid. You see water flowing out through the holes. Close the opening in the lid with your finger and press it hard. What happens? The flow of water stops. Release the finger. What happens now? Once again water flows out through the holes. Air pressure works the sprinkler. You can use this for sprinkling water on tiny seedlings.
2. A water bottle fountain: Take a plastic water bottle with a lid fitted with a straw. Fill the bottle with water and close the lid tight. Now press the water bottle. Air pressure pushes water into the straw with force. So water rushes out of the straw in the form of a fountain which rises quite high!
3. To let condensed milk or oil flow out of a sealed tin faster: If you make just one hole in a sealed tin, the liquid will only ooze out of it slowly. If you make a smaller hole on the other side of the sealed lid, the flow of liquid is much faster.

   This is because air enters into the tin through the smaller hole and pushes the liquid out through the larger hole.

4. Can you pour air like a liquid? This is possible. Hold two empty tumblers under water. Place the mouth of one beside the other as shown in the figure. Air bubbles from the lower one rise up and flow into the other. Now you have actually poured air from one tumbler into the other.
5. Pushing an egg into a bottle: Take a bottle whose mouth is just as wide as an egg cup. Take an egg, boil it and remove its shell. Light a piece of paper and drop it into the bottle and quickly place this egg on its mouth. What do you see?

   The egg just fits into the mouth like an egg cup. But after some time, it falls into the bottle.

   This is because the burning paper uses up oxygen in the air and so air pressure in the bottle decreases. Now, outside air which has greater pressure pushes the egg into the bottle!
6. Watch how compressed air is used in service stations to inflate motor and lorry tyres.
7. Watch how house lizards (geckos) move upside down on a ceiling. The cushioned pads under their feet act as suckers by creating a vacuum between the wall and the feet.

Exercises

1. Answer briefly:
   a. How can empty drums be made into a raft?
   b. When does a football bounce well?
   c. What happens in a syringe filled with a liquid when its handle and piston are pushed forward?
   d. How does water get into a straw?
   e. In an experiment that demonstrates that air has weight, which balloon goes down? Why?
   f. How can you show that air can displace a liquid, which is another form of matter?
   g. Why does a rubber sucker get glued to a smooth surface?
   h. What is the function of the blotting paper collar in an experiment which shows that air exerts pressure?
   i. How can you show that air can be poured like a liquid?
   j. What is the similarity between an ink-filler and a pen with a self-filler?
2. Answer in detail:
   a. Describe an experiment to show that a cork can be made to float at a level lower than that of the surrounding water. Draw simple diagrams.

b. How can you let coconut milk flow from a tender coconut without opening it fully? Recollect the various examples given in the text to help you think of a suitable method.

c. How do you make a small water sprinkler for watering a tiny seedling?

d. How can you convert your water bottle into a mini-fountain?

e. How does a burning piece of paper help in pushing a boiled egg into a bottle whose mouth is just as wide as the egg?

f. Prepare soap solution in a cup. Use a straw to blow bubbles. How are the bubbles formed? Why do they burst? Explain.

3. Give reasons for the following:

a. Cycle and car tyres are provided with air filled tubes.

b. Empty tins are tied to the back of a beginner when he wants to learn swimming.

c. A burning material inside a container creates a vacuum in it.

d. The liquid in a straw does not flow out when it is closed on top by a finger.

e. Air pillows get flattened out after some time.

4. Complete the following statement:

a. Man sends weather satellites out into space to ....

b. Anything that has weight must ....

c. Compressed air exerts ....

d. A hot tin can with steam issuing out of its gets jammed (misshapen) when ....

e. A cardboard adhering to the rim of a water filled tumbler does not fall down when it is ....

5. Correct the following statements:

a. A lift pump has three valves.

b. A siphon tube can be filled with any liquid when we want to transfer kerosene from a large barrel into a small can.

c. An injection needle is attached to a medicine dropper to inject medicine into our blood.

d. Air is sucked in from the short tube to let water come out like a fountain from the longer tube with a spout in a wash bottle.

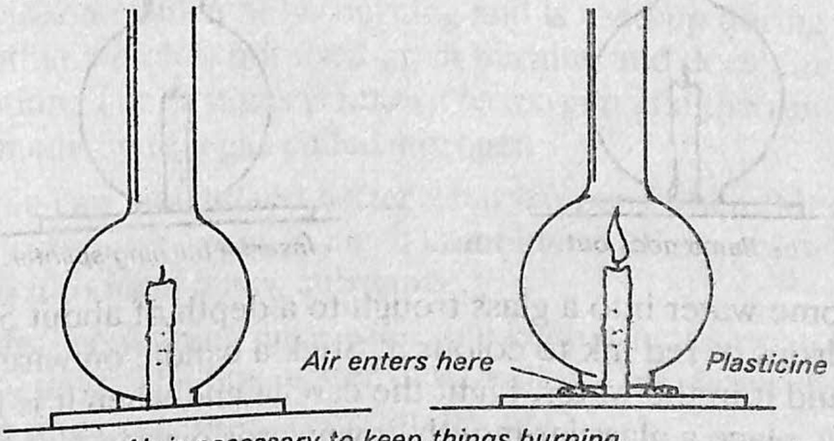
e. If a liquid has to be transferred using a siphon tube, the larger barrel should be kept at a lower level than the smaller can.

5. Burning, rusting and the composition of air

Burning

From very early times man knew how to make fire. Fire kept him warm, cooked his food, helped him to see things around him in the dark and protected him from wild animals when he slept. Man is curious by nature and he gains knowledge by asking the questions 'why', 'how', and 'what'. One of the questions he asked himself was, 'what happens when things burn?'

1. Stick a small candle on a cardboard placed on a table and light it. Take a small glass chimney (like that found on a chimney lamp) and place it over the candle. Note what happens. The candle keeps burning for a while and then the flame goes out.

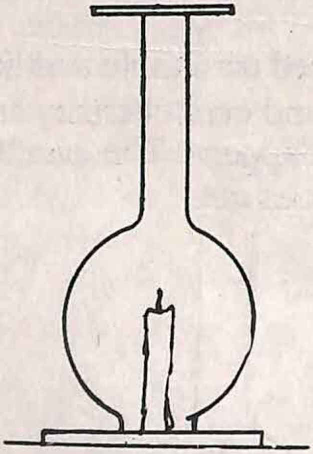


Air is necessary to keep things burning.

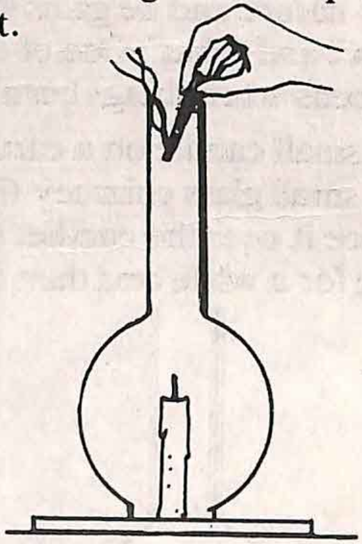
Now remove the chimney and attach some plasticine to its base. Light the candle and put the chimney back over it. You will find that the candle keeps burning. The pieces of plasticine raise the base of the chimney and allow air to enter through the gaps.

This experiment shows that air is needed to keep things burning. In the first case the flame went out because there was no continuous supply of air. In the second case, the air above the candle helped the candle to burn for a while. When the air became hot it rose and left the chimney through its mouth. Fresh air entered from below to keep the candle burning. You would have noticed that in a chimney-lamp if the side holes are blocked, the flame becomes smoky and finally dies out. This is because the chimney does not get enough air.

2. Stick a small candle on a sheet or cardboard. Light it and invert a glass chimney over it. Cover the mouth of the chimney with a lid. You will see that the flame goes out after a while. Light a splinter, remove the lid and quickly plunge the burning wooden splinter into the chimney. The fire is soon put out.



The flame goes out.

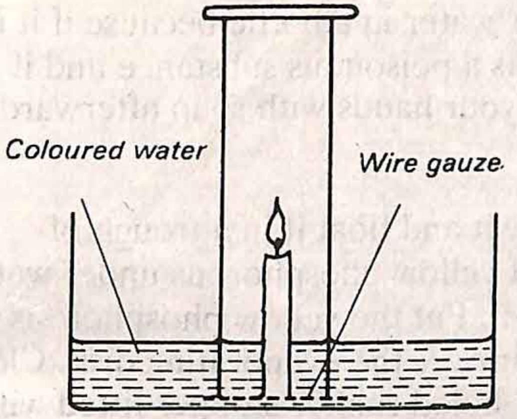


Insert a burning splinter.

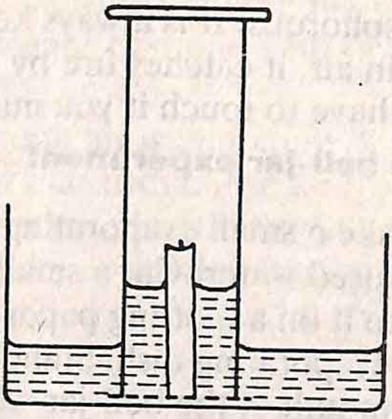
3. Pour some water into a glass trough to a depth of about 5 cm. Add a few drops of red ink to colour it. Stick a candle on wire gauze and stand it in the water. Light the candle and when it is burning steadily, place a glass jar mouth downwards over it. Note what happens.

It is seen that the candle flame goes out and water rises a certain height in the jar This experiment shows that when a candle burns in air some of the air is used up. Water rises up in the jar to take its place. We can conclude that, when a thing burns in air, part of the air is used up for burning.

Pour some water into the trough and carefully holding the wire gauze, remove the candle without allowing air to enter the jar or



Light the candle and invert a jar over it.



The water level rises.

escape from it. Slip a cover over the mouth of the jar and stand the jar in the upright position with the cover still over its mouth. Light a wooden splinter, quickly remove the cover and plunge the splinter into the jar. What do you notice?

From these observations, we learn that air is a mixture of at least two gases: one which helps burning and is used up during burning, and another which is not used up in burning and does not support combustion. The first gas is known as oxygen and the remainder is mainly made up of a gas called nitrogen.

Now we can understand better what happens when things burn. When a substance burns in air, it combines with oxygen which is added to it to form a new substance.

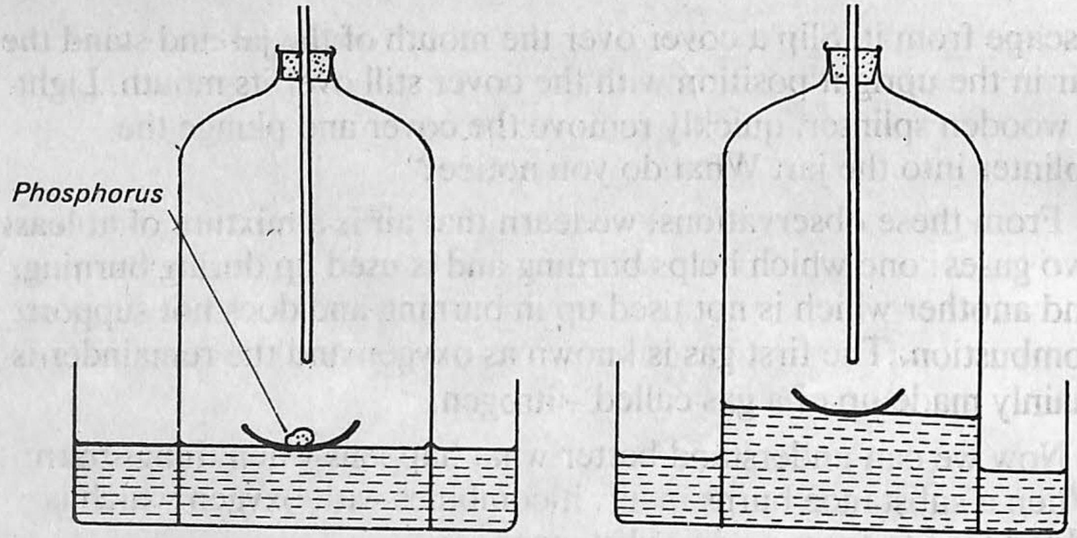
4. Take a dish containing lime water and keep it in the open for a couple of days. The lime water turns milky. This shows the presence of carbon dioxide gas in the air.
5. Pour some water into a tumbler and add a few pieces of ice to it. The outer surface of the tumbler becomes dim because of the condensation of water vapour on it. This shows that air also contains water vapour. The formation of dew, frost, rain, sleet and clouds shows the presence of water vapour in the air.

How much air is used up for burning?

Let us now try to find out how much air is used up for burning. To do this we use a highly active substance known as yellow phosphorous. It is always kept under water in a bottle because if it is left in air, it catches fire by itself. It is a poisonous substance and if you have to touch it you must wash your hands with soap afterwards.

The bell-jar experiment

Take a small evaporating dish, dry it and float it in a trough of coloured water. Cut a small piece of yellow phosphorous under water. Place it on a blotting paper and dry it. Put the yellow phosphorous in the evaporating dish. Stand a bell-jar over the evaporating dish. Close the mouth of the bell-jar with a one-holed rubber stopper fitted with a long glass rod as shown in the figure. Grease the glass rod with vaseline so that the rod can be moved up or down through the hole in the stopper, without being loose.

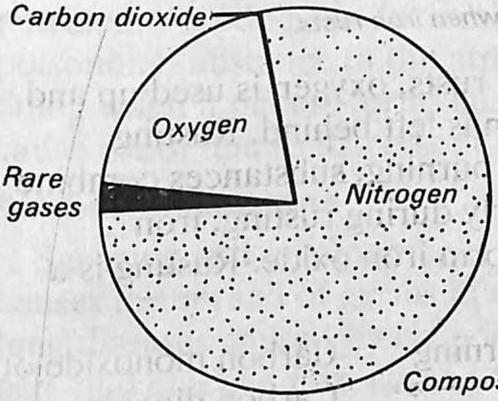


The bell jar experiment

Stick a piece of paper outside the bell-jar to mark the level of water inside the jar. Divide the space above the water level into five equal parts. Mark the parts. Now remove the rubber stopper and warm the glass rod over a flame. Replace the stopper and push the rod down so that its hot end just touches the phosphorous. Pull up the rod by a few centimetres.

The yellow phosphorous burns and white fumes are formed. These fumes are soluble in water. When the yellow phosphorous stops burning and the white fumes disappear by getting dissolved in water, the level of water rises up in the bell-jar by one-fifth. This shows that one-fifth of the air has been used up. This means that one-fifth of air consists of oxygen.

The experiments on burning have shown that air is a mixture of at least two gases, oxygen and nitrogen. About one-fifth of the air consists of oxygen and the remainder consists mainly of nitrogen. Air also contains carbon dioxide, water vapour, dust particles and inert gases (helium, neon and argon). The composition of dry air by volume is shown in this figure.



Composition of dry air

Besides gases, dust particles and other small living organisms can be found floating in air. Thus everytime we breathe in air, we are taking in not just a single gas, but a mixture of many gases together with dust particles, water vapour, pollen grains and bacteria.

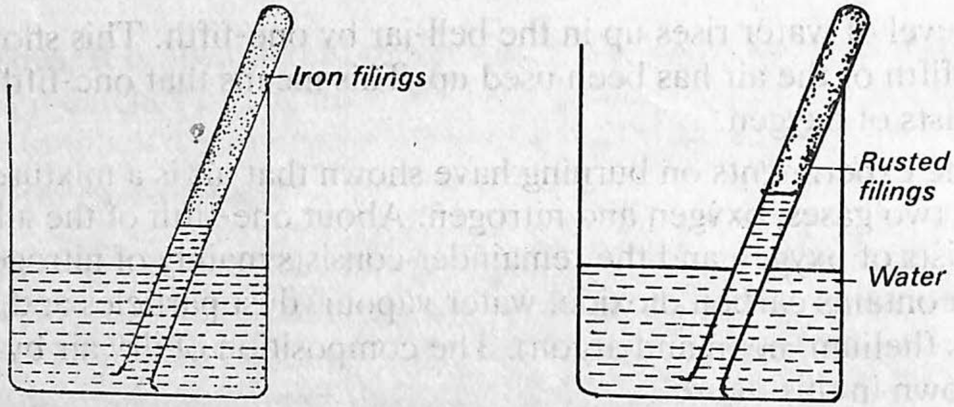
Rusting

All of us know that when we leave a shining piece of iron in a moist place, its outer surface becomes reddish brown. We say the iron has rusted. What actually happens when iron rusts?

Take a test tube and wet its inner surface. Put a teaspoonful of iron filings into it. Shake the test tube so that the iron filings get stuck all over the inside of the test-tube. Stand the test tube mouth downwards in a beaker containing 3-4 cm of water. Mark the level of water inside the test tube. Let the test tube remain in the water for a few days. Note what happens.

You will see that the iron filings get rusted and the water level inside the tube rises up to one-fifth of the space above the earlier water level.

Hold your thumb over the mouth of the test tube and turn the test tube right way up. Lift your thumb and quickly plunge a burning wooden splinter into the tube. The wooden splinter is put out.



One fifth of the air is used up when iron rusts.

This experiment shows that when iron rusts, oxygen is used up and nitrogen which does not help combustion is left behind. Rusting appears to be similar to burning. During burning, substances combine with oxygen to form their oxides. Similarly during rusting, iron combines with the oxygen of the air to form iron oxide. Rusting is a slow form of combustion.

$$\text{Carbon} + \text{Oxygen} \xrightarrow{\text{Burning}} \text{Carbon monoxide or Carbon dioxide}$$

$$\text{Iron} + \text{Oxygen} \xrightarrow{\text{Rusting}} \text{Iron oxide}$$

Burning is a quick process while rusting is a slow process. During burning a lot of heat is produced but this is not so during rusting.

To avoid rusting

When iron rusts, it is eaten away. There are several ways of preventing rusting. One way is to coat the surface of the iron with a thin layer of oil or grease, so that water and air do not come into contact with the iron. Oil, however, can easily be rubbed off, so it is better to use paint. Paint, when dry, sticks to the metal and does not allow air to attack the metal.

Sometimes iron sheets are dipped into molten tin. When they are taken out a thin layer of tin is formed on them. This process is called tin-plating and it stops the rusting of iron. Sometimes iron sheets are dipped into molten zinc to prevent rusting. Such sheets are called galvanized iron sheets.

Air pollution

You have already learnt how a beam of light entering a room can show dust particles suspended in the air. You can actually see thousands of them dancing around, moving swiftly up and down!

Apart from dust, air contains impurities such as smoke from chimneys and automobiles, poisonous fumes from factories, tiny pollen grains, spores of non-green plants and innumerable germs that cause disease. Thus air is polluted with these impurities.

In recent years, the smoke given out by factories which use petroleum products as fuel mixes up with fog and forms a dense, poisonous substance in the atmosphere called 'smog' (smoke and fog). Smog when it occurs forms such a thick covering that it can even cause death due to its poisonous nature.

Air-borne diseases

Sneezing and common cold are caused by air pollution. This also causes the spread of germs in the air. Pneumonia and bronchitis are lung diseases caused by air pollution. The germs of tuberculosis, small pox and chicken pox spread through the air.

Need for pure air

Air is very important for all living things. Therefore pure air is necessary for healthy living.

The oxygen and carbon dioxide chain

The air which we breathe in contains a large proportion of nitrogen and oxygen and very little carbon dioxide. Part of the oxygen inhaled is taken by the body to burn food to give energy to the body. When this happens carbon dioxide is formed. Thus the air which we exhale contains the unused nitrogen, some oxygen and a greater proportion of carbon dioxide. There are billions and billions of living creatures on the earth which are consuming oxygen from the air and exhaling carbon dioxide instead. Because of this,oxygen in the air should diminish and carbon dioxide should increase. But nature maintains the balance and this does not happen.

During the day plants take in carbon dioxide to form starch and sugar with the help of chlorophyll. They then give out oxygen. Thus the ratio of carbon dioxide and oxygen in the air remains almost the same, and the balance is maintained.

The active and inactive parts of air

Oxygen in the air helps things to burn, breathe or rust. Therefore oxygen is called the active part of air.

Nitrogen does not help substances to burn in it. So it is called the inactive part of air.

Use of water vapour in air

Water vapour in the air helps in the formation of clouds that bring us rain. Water vapour in the air is needed for certain industries such as cotton textile industries for spinning fine quality yarn.Apart from bringing rain or snowfall, water vapour condenses as dew or frost, sleet and hail.

Things to remember

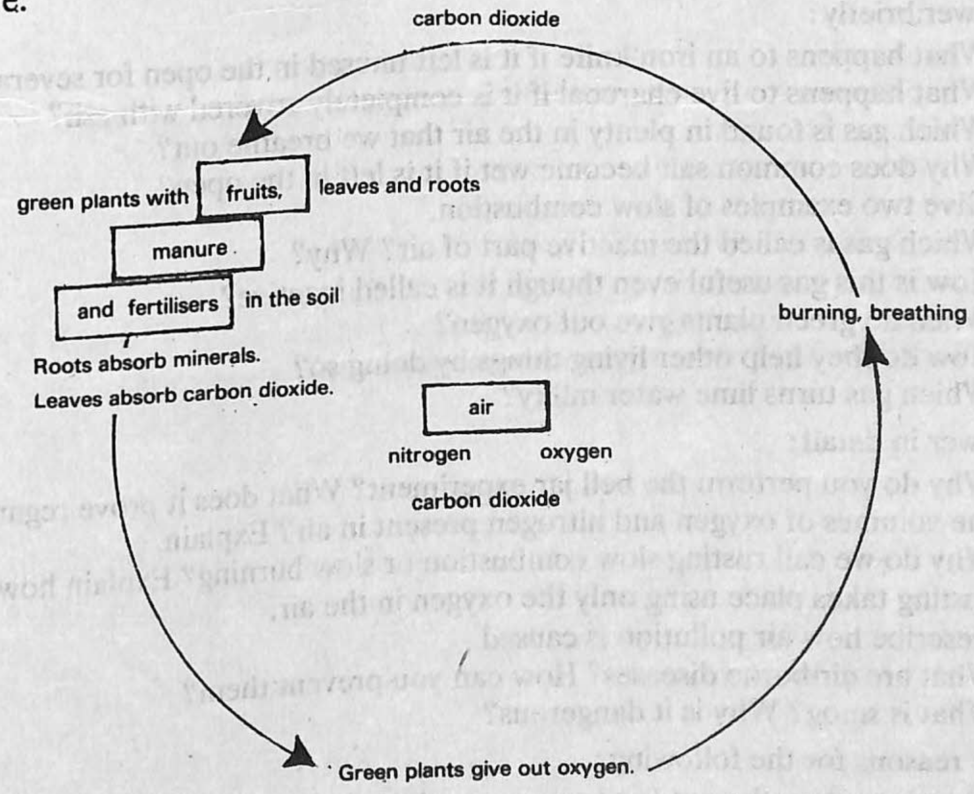
1. Air consists of an active part which enables living things to breathe, substances like wood, coal and oil to burn and iron to rust. This active part of the air is oxygen.
2. Air consists of an inactive part also which remains unaltered when breathing, burning or rusting occurs.
3. Burning is also called combustion. Burning of a candle, oil or paper are examples of rapid combustion. Burning of food within the body tissues (breathing) and rusting of iron are examples of slow combustion.
4. The products of burning and breathing are carbon dioxide and water vapour.
5. Green plants act as air purifiers. They take in carbon dioxide, which we breathe out, to prepare starch and give out oxygen for us to breathe. Thus plants and animals are interdependent.
6. Oxygen, nitrogen, carbon dioxide and water vapour are useful parts of air.
   a. Oxygen is used for breathing, burning and rusting.
   b. Nitrogen is used in the preparation of fertilisers or plant food.

c. Carbon dioxide is used by green plants for the preparation of starch.
d. Water vapour in the air helps in the formation of rain and snow.

7. Air contains about 78.00% of nitrogen, 21.00% of oxygen, 0.03% of carbon dioxide and around 1% of other gases which are totally inactive.
8. Impurities like dust, smoke, smog and germs cause air pollution.
9. Air must be kept pure by growing green plants around us.
10. Air-borne diseases should be prevented.

Things to do

1. The air cycle: You have learnt about the water cycle. You must have also drawn it in your notebook. You can also make a sketch of the air cycle. Look at this figure. Draw it yourself and write a paragraph on what you see in the figure.



2. You can show how burning of food within our body tissues gives out carbon dioxide.

Burn a spoonful of sugar, holding it over a candle flame. Keep an inverted bottle over it to collect the gas thus produced. When the sugar burns away completely, quickly turn the bottle erect and add clear lime water to it. It turns milky, showing that carbon dioxide is given out by burning food.

3. You can also show that burning substances give out water vapour. Do the following experiment.
   a. Roll a piece of paper and light it. Keep the flame close to a slate. You will see droplets of water settling on it.
   b. Burn a candle within a bottle and cover it with a lid. Droplets of water collect on the sides of the bottle.
4. Hold a mirror or a slate in front of your mouth and breathe out air. You will find droplets of water settling on it. Blow air into a cup of lime water using a straw. It turns milky. The above two experiments show that we breathe out water vapour and carbon dioxide. These are the products of burning food in our body tissues.

Exercises

1. Answer briefly:
   a. What happens to an iron knife if it is left unused in the open for several days?
   b. What happens to live charcoal if it is completely covered with ash?
   c. Which gas is found in plenty in the air that we breathe out?
   d. Why does common salt become wet if it is left in the open?
   e. Give two examples of slow combustion.
   f. Which gas is called the inactive part of air? Why?
   g. How is this gas useful even though it is called inactive?
   h. When do green plants give out oxygen?
   i. How do they help other living things by doing so?
   j. Which gas turns lime water milky?
2. Answer in detail:
   a. Why do you perform the bell jar experiment? What does it prove regarding the volumes of oxygen and nitrogen present in air? Explain.
   b. Why do we call rusting slow combustion or slow burning? Explain how rusting takes place using only the oxygen in the air.
   c. Describe how air pollution is caused.
   d. What are air-borne diseases? How can you prevent them?
   e. What is smog? Why is it dangerous?
3. Give reasons for the following:
   a. The air we breathe out has less oxygen than the air we breathe in.
   b. Green plants must be grown near where we live.
   c. Lime water kept exposed to air turns milky.

d. Iron rods in windows are painted with varnish.

e. Live caterpillars die when they are kept in a closed bottle whereas they can live if a few holes are made in the bottle's lid.

4. Match the following:

oxygen	0.03% of air
carbon dioxide	smog
water vapour	nearly 1/5th of air
smoke of petroleum	remains unaltered in the air we breathe in and out
nitrogen	condenses as dew drops

5. Fill in the blanks using 'oxygen', 'carbon dioxide' or 'nitrogen'.

a. Burning substances use __________ and give out __________.

b. As .... is the inactive part of air, it is not used for burning or rusting.

c. Green plants act as air purifiers by making use of .... for the preparation of starch and giving out .... for all living things to breathe.

d. .... and .... form the chief gases of the air.

e. .... turns lime water milky.

6. Solvent power of water and its importance in life processes

Importance of water to man

You must have learnt in history that ancient civilisations flourished on river banks where people could got plenty of water for their daily life, for growing crops and for their livestock. The Indus Valley civilisation is a good example. Thus we know the importance of water for mankind.

Modern man has built dams and reservoirs to irrigate cultivable lands; has deepened channels for navigation and has built cities and factories, near water sources. He generates electric power from swift-flowing rivers and streams and from waterfalls. He has started using desalinated sea water (sea water from which salt has been removed) for several purposes. By his efforts, man has learned to make use of natural waters to shape the course of human development. Next to the air we breathe, water is probably the most essential thing in our lives.

Solvent power of water

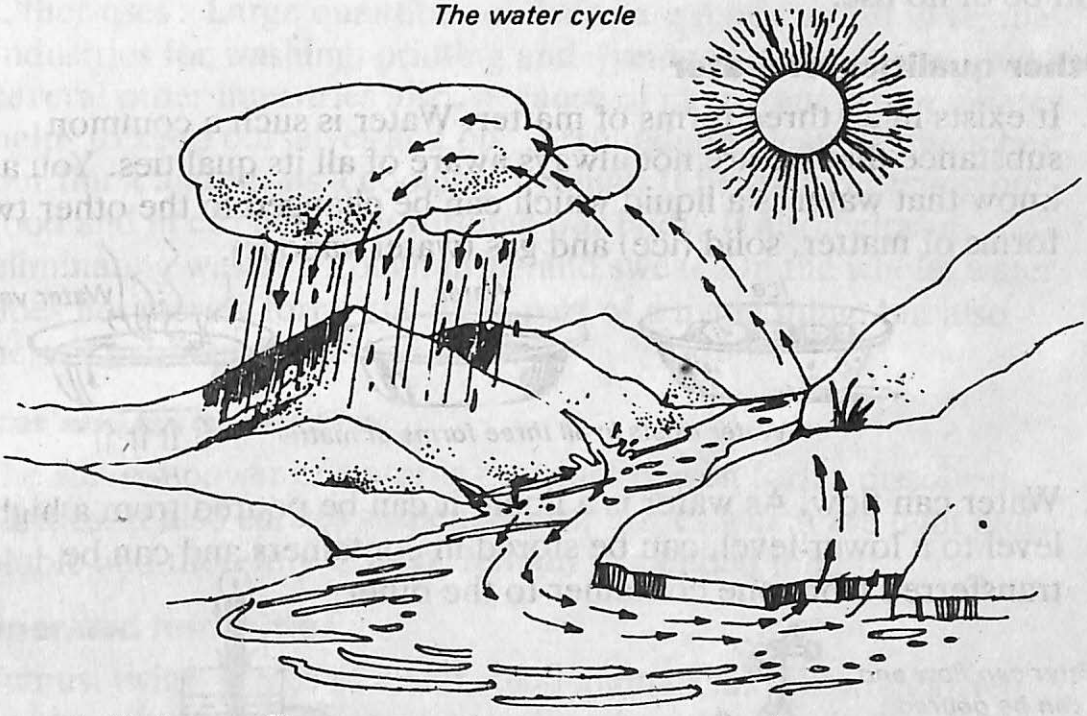
You have already studied about water being the universal solvent which can dissolve many substances to form their solutions. Sea water is thus a solution of several salts in water, the main salt being common salt or sodium chloride. Therefore, it is by evaporating sea water in salt pans that we get this useful salt. We use this salt for cooking and as a preservative for many foods.

As water runs over the earth, or seeps through the porous soil, it dissolves some of the substances found there. This water is finally carried to lakes or oceans through rivers. Thus lakes and oceans contain dissolved salts.

The water cycle

Rain clouds are formed by the evaporation of water from lakes and oceans. We get rainfall from these clouds. The rain water reaches the lakes or oceans and once again evaporates to form rain clouds. This is called the water cycle and it is repeated over and over again.

The water cycle



Water in living cells

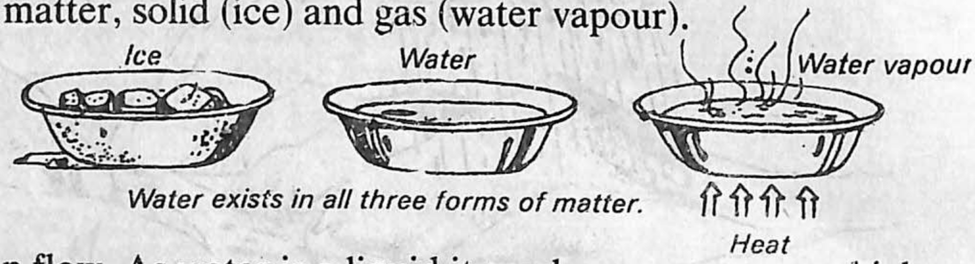
All living things contain water and need it for their various life processes. Over two-thirds of our body consists of water. Ninety parts out of every hundred parts of our blood contains water. Our muscles contain over eighty parts of water out of hundred parts. To maintain the necessary water supply to our body tissues, we drink a lot of water daily and eat food which contains plenty of water.

Water shapes the surface of the earth

The sun, the wind and running water in streams and rivers are the chief forces that cut rocks into various shapes and form hills, mountains and valleys. This process of erosion of soil caused by the three forces results in the formation of sediments. As running water slows down, it brings in dissolved minerals and tiny bits of rocks along with it which form the sediments. This leads to the formation of broad smooth fields and large fertile farm lands near river beds. On the other hand, heavy floods in the rivers, due to continuous, heavy rainfall, results in the destruction of these fertile farm lands as soil particles will be washed away and carried to the lakes or oceans where they will be of no use.

Other qualities of water

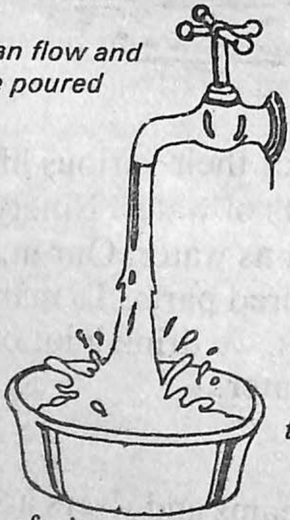
1. It exists in all three forms of matter. Water is such a common substance that we are not always aware of all its qualities. You all know that water is a liquid which can be changed to the other two forms of matter, solid (ice) and gas (water vapour).

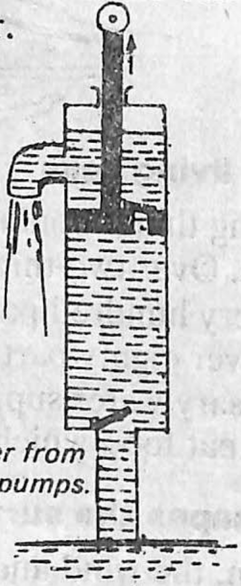


Water exists in all three forms of matter.

2. Water can flow. As water is a liquid it can be poured from a higher level to a lower level, can be stored in containers and can be transferred from one container to the other.

Water can flow and it can be poured





We can draw up water from the water table through lift pumps.

3. Use of air pressure: Using air pressure, we can suck up water from the water table through lift pumps and transfer liquids from a big container into a smaller one using a siphon tube.
4. To generate electricity: The force of flowing water in swift-flowing rivers, waterfalls and reservoirs is used to turn huge water turbines to generate electricity.
5. It determines the weather. The quantity of water vapour present in the air, the amount of rainfall or snowfall in a place, are some

factors which determine the weather of a particular region.

6. Other uses: Large quantities of water are made use of in textile industries for washing, printing and dyeing cloth. Water is used in several other industries also, because of its solvent power. Water helps to keep ourselves and our surroundings clean. It quenches our thirst and forms a cooking medium. It helps in digesting our food and in circulating it through our body. It also helps in eliminating wastes through urine and sweat. On the whole, water does not merely form the main part of a living thing, but also helps in various life processes.

Water and its impurities

The solvent power of water is the chief reason for its dissolved impurities. It also carries suspended impurities which are light and insoluble and therefore float or remain suspended in it.

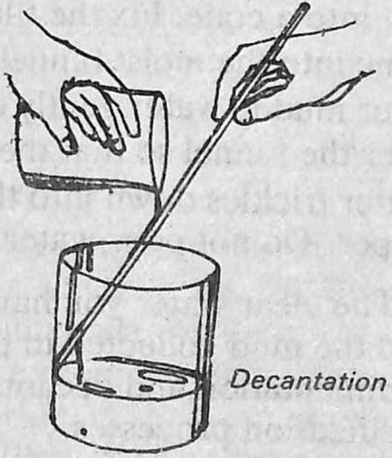
Suspended impurities

Humus, twigs, pieces of wood, dead animals and silt are carried away by swift-flowing rivers, especially when they are in flood. These form the suspended impurities in water. Sewage water contains both suspended and dissolved impurities.

Removal of suspended impurities

When flood waters recede or when the speed of running water is reduced, the suspended impurities, including mud and silt, are made to settle down.

In city water supply schemes, suspended impurities are allowed to settle down in huge sedimentation tanks. The processes of sedimentation and decantation and filtration are also done on a small scale to remove suspended impurities.

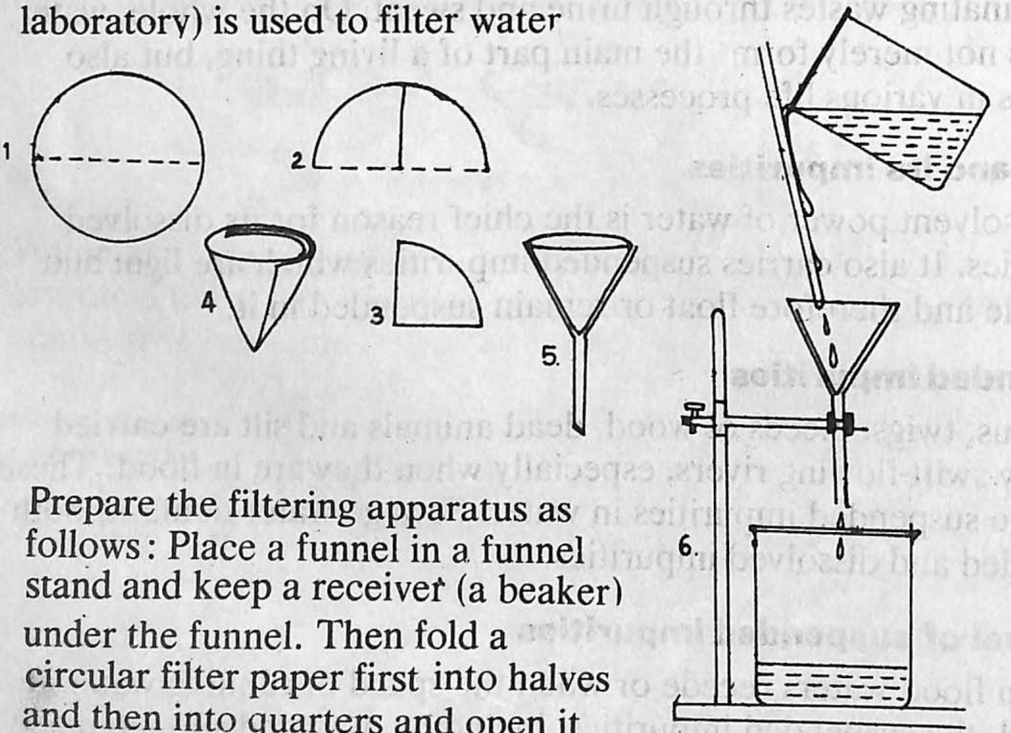


Decantation

1. Sedimentation and decantation: As you have already learnt, this is a rough and a rapid process as there cannot be total removal of

suspended impurities. The impure water is kept undisturbed in a container allowing the tiny particles of mud or silt suspended in it to settle down at the bottom. Then the clear water is decanted, leaving the impurities behind.

2. Filtration: To ensure the removal of all the suspended impurities in water, filtration is carried out. This is a slow, but thorough process where either a thin cloth (at home) or a porous filter paper (in the laboratory) is used to filter water



Filtration

Prepare the filtering apparatus as follows: Place a funnel in a funnel stand and keep a receiver (a beaker) under the funnel. Then fold a circular filter paper first into halves and then into quarters and open it out into a cone. Fix the filter paper cone into the moist funnel. Then pour muddy water gently over a glass rod held in a slanting position over the funnel so that the filter paper may not tear. See how clear water trickles down into the receiver through the porous filter paper. Do not pour water beyond the edge of the filter paper.

The clear water you have collected in the receiver is the filtrate and the mud collected in the filter paper is the residue. Sedimentation and decantation and filtration are very simple purification processes.

Some of us use a home-filter to get clear drinking water. Water boiled and cooled and then filtered is best for drinking purposes as even ground water might contain disease germs which can be killed only by boiling.

Water being a good solvent dissolves many salts found in the soil. It also dissolves animal wastes and contains many harmful germs. Therefore it is very essential to purify natural water of dissolved impurities and germs before it is used for drinking and cooking purposes.

How to kill germs: We can get rid of germs by boiling water. Exposure to direct sunlight also kills germs. Chemicals such as chlorine and potassium permanganate in very small quantities kill germs but do not affect us. You must have noticed a different smell in your tap water during the rainy season. This is due to a greater level of chlorination of water. Water is pumped from the sedimentation tanks into the chlorine towers. Here a steady stream of chlorine is sent in to kill harmful germs before it is pumped into the reservoirs for supplying a city. Use of bleaching powder which contains chlorine helps in killing germs in our water tanks and wells. Even a few crystals of potassium permanganate may be added to kill germs in a water tank. For the same reason, it is safe to wash green, leafy vegetables, especially greens, in water to which a pinch of potassium permanganate has been added. This prevents us from getting infected by contaminated foodstuff.

Remember that water-borne diseases like cholera, dysentery and typhoid can be avoided by using clean water, devoid of germs, for drinking and cooking purposes.

Other purification processes

You know that water, as a solvent, dissolves many solids or solutes to form solutions. If the solutes dissolved in water are useful, then water can be evaporated to recover the solute particles from the solution. This is done in the laboratory by a process called evaporation. Common salt or sodium chloride, in the form of crystals, is obtained by evaporating sea water in shallow pans or salt pans by the heat of the sun. You may have seen this being done on the seashore in certain places.

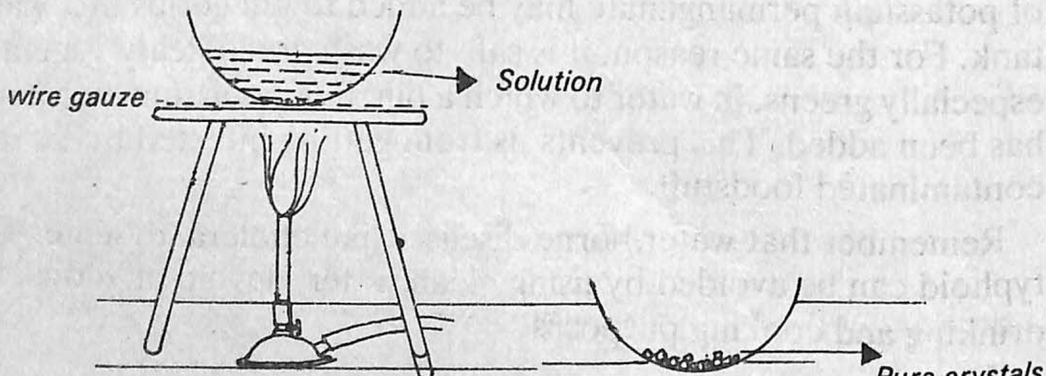
Evaporation is carried out in the laboratory to recover pure forms of solutes as crystals, through crystallisation after evaporation. Only the pure solute will be formed into crystals and impurities will remain in the evaporating dish along with a little solvent.

What is a crystal?

A crystal is a solid having definite geometrical shape, bounded by flat, regular surfaces.

Crystallisation by evaporation

This is done by pouring a salt solution into a porcelain evaporating dish (china dish) kept on a wire gauze, over a tripod stand. The solution is heated by a gas burner or a spirit lamp. Moderate heating causes the water (solvent) to evaporate gradually leaving the solution more and more concentrated with the solute. At a particular stage, a thin crust will form on the surface of the solution. Heating must be stopped at this stage. The solution should be left to cool gradually, after the evaporating dish has been covered with a filter paper.



Crystallisation by evaporation

Gradual cooling results in the formation of well-shaped, shiny crystals of the solute. The impurities will be left in the solution which can be decanted and the crystals recovered. The crystals may be dried gently within folds of filter paper.

Crystals of sodium chloride and copper sulphate can be prepared likewise in the laboratory. Crystalline cane sugar and sugar candy are also obtained from sugarcane juice by this method, but on a larger scale in factories.

Thus water helps as a solvent in purifying many salts.

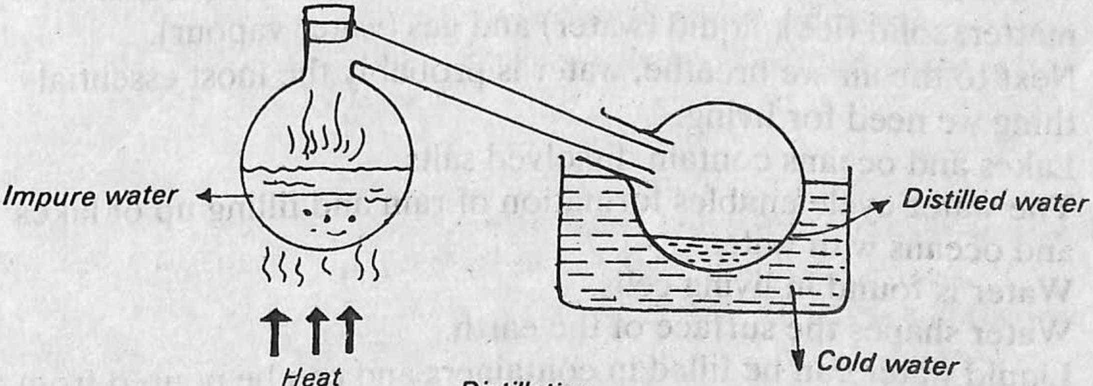
Crystallisation by preparing a very concentrated solution

In this method, the solvent (water) must be heated gently, powdered solute (salt) added gradually and the solution stirred with a glass rod. As the temperature increases, more solute particles get dissolved. Heating is stopped after a certain stage, when no more solute can be added and dissolved. The concentrated solution is now left undisturbed, covered with a filter paper. Gradual cooling causes extra solute that has gone into the solution to be thrown out in the form of shiny, well-shaped crystals. These crystals can be recovered in the same manner as before.

Crystals of sodium chloride

To recover the pure solvent

Pure solvent is obtained from a liquid which has dissolved impurities in it by the process of evaporation and condensation. Distilled water needed for laboratory purposes, for preparing medicines, and for car batteries is prepared by this process. This is called distillation.



Distillation

Distillation is a process by which pure solvent is obtained from a solution. To help evaporation and condensation of the solvent, a suitable apparatus is needed. This is called a retort. It is made of glass. It is provided with a delivery tube and a mouth with a short neck and a stopper.

The retort is placed over a wire-gauze kept on a tripod stand. The solution (muddy water), whose solvent (water) has to be recovered, is poured into the retort through a funnel and the stopper is placed over its mouth. A round-bottomed flask is inserted into the delivery tube as the receiver. It is kept constantly cooled by placing it in a trough of cold water.

On heating the solution, the vapours of pure solvent (water) rise up and escape through the delivery tube. The vapours condense in the cold receiver. Thus pure solvent is recovered from its solution. The impurities remain in the retort in the form of a concentrated solution.

This is how distilled water is prepared in the laboratory. The same principle is followed for its manufacture on a larger scale.

Purest sample of natural water

Rain water collected after a few showers is the purest sample of natural water as it will not contain any suspended or dissolved impurities. It is almost as pure as distilled water!

Things to remember

1. Water is a universal solvent.
2. Water is a very common substance available in three forms of matter, solid (ice), liquid (water) and gas (water vapour).
3. Next to the air we breathe, water is probably the most essential thing we need for living.
4. Lakes and oceans contain dissolved salts.
5. The water cycle enables formation of rain and filling up of lakes and oceans with water.
6. Water is found in living cells.
7. Water shapes the surface of the earth.
8. Liquid water can be filled in containers and can be poured from a

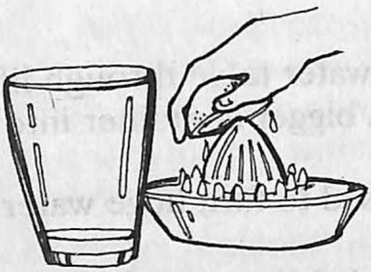
higher level to a lower level.

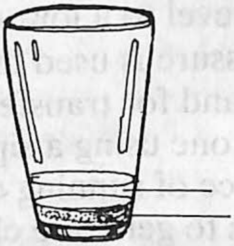
9. Air pressure is used to lift water from the water table through lift pumps and for transferring a liquid from a bigger container into a smaller one using a siphon.
10. The force of running or flowing water is used to turn huge water turbines to generate electricity.
11. The presence of water vapour in air and rainfall or snowfall determine the weather in a particular area.
12. Water contains suspended and dissolved impurities.
13. Sedimentation and decantation, and filtration help in the removal of suspended impurities.
14. A home filter is used to get clear, drinking water.
15. Water boiled and cooled and then filtered is best for drinking purposes as boiling kills germs.
16. Chlorine, bleaching powder containing chlorine and potassium permanganate are chemicals used in very small quantities to kill germs in water.
17. In most cities, we get chlorinated water through the water supply system.
18. By the process of crystallisation through evaporation, pure solute crystals can be obtained using a suitable solvent, water being the most suitable one.
19. Crystals can also be obtained by preparing a warm, concentrated solution of the solute and gradually cooling it to get well-formed crystals.
20. A crystal is a solid having definite geometrical shape, bounded by flat, regular surfaces.
21. Distillation is a process of evaporation and condensation. It is used to get the purest sample of a solvent. Distilled water is prepared by this method.

Things to do

1. Construct a home filter as shown in the figure using clean gravel, coarse sand, fine sand and bits of charcoal in layers in a porous pot.

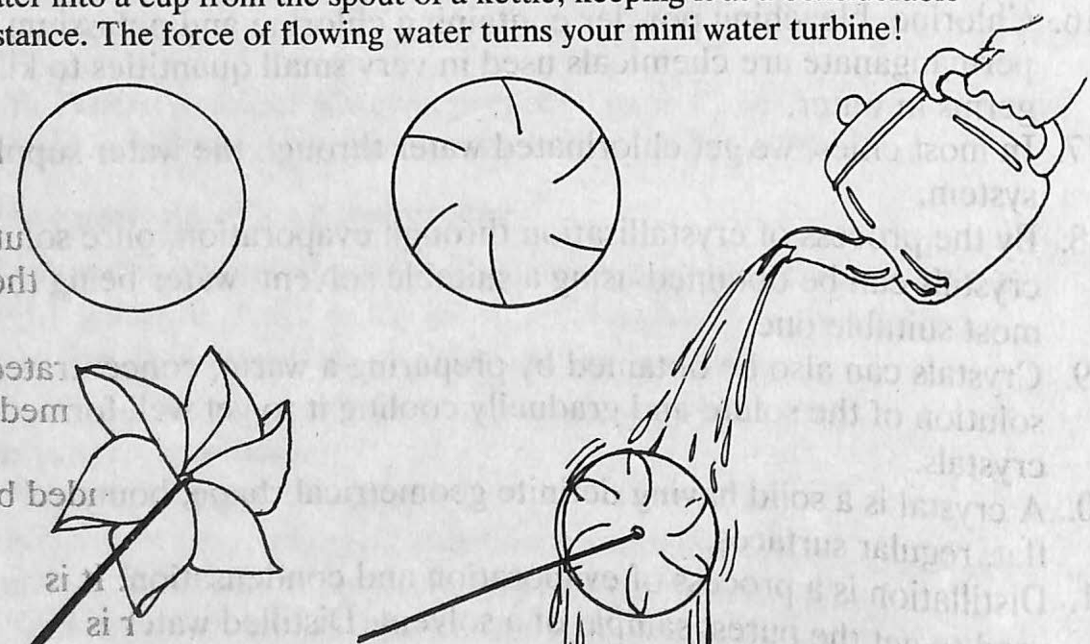
   Fine sand, coarse sand and gravel filter suspended impurities and charcoal bits absorb poisonous germs found in water.
2. Squeeze an orange or fleshy leaf. You get a lot of juice. Allow it to settle down.





Clear liquid separates out. This shows the presence of water in living tissues.

3. Visit a hydro-electric power station if possible and observe how the water turbines are turned by swift-flowing water from a dam or a reservoir. See how mechanical energy is used to produce electricity.
4. To construct a water turbine: Take a circular tin-sheet (found in sealed tins). Mark lines as shown in the figure and cut with a pair of scissors. Twist the cut ends gently to form tiny cups. Fix the centre to a stick or a metallic rod. Now you have made a mini water turbine. (Hold it in your left hand and pour water into a cup from the spout of a kettle, keeping it at a considerable distance. The force of flowing water turns your mini water turbine!



5. Keep a cup of ice-cold water on a table. Wipe its outer surface. After some time, you find droplets of water settling on the outside of the tumbler. This shows the presence of water vapour in the air which settles on the cool sides of the tumbler.
6. Prepare crystals of sugar or common salt at home by evaporation or by cooling its concentrated solution. Bring the crystals to your class and display it in the display corner of your classroom.

7. Keep a clean glass tumbler under the spout of a kettle in which a little water is made to boil. Collect the vapour that comes out of the spout in the tumbler. Droplets of water get condensed in it. You have actually collected distilled water by evaporation and condensation.

Exercises

1. Answer briefly:
   a. Why is water called a universal solvent?
   b. How can you show that living cells contain water?
   c. Name the three forces which are responsible for cutting rocks into various shapes.
   d. State any three qualities of water.
   e. Why is sea water salty?
   f. How is salt obtained from sea water?
   g. What are filtrate and residue?
   h. Why do you keep bits of charcoal in a home filter?
   i. Why should drinking water be boiled?
   j. Name three water-borne diseases. .
2. Answer in detail:
   a. What happens when a hot, concentrated solution of sugar is made to cool down gradually? Explain the experiment in detail.
   b. What is distillation? How is distilled water prepared?
   c. Explain in a paragraph, how water shapes the surface of the earth.
   d. Explain how you can make a mini water turbine. How is electricity produced by using the force of water flowing from a great height?
   e. How can germs present in water be killed on a large scale?
   f. Which materials normally form suspended impurities in water? Describe a method by which they can be effectively removed. Draw a neat, labelled sketch of the apparatus you would use for this purpose.
   g. What are crystals? How can they be produced by evaporation? Describe the procedure.
3. Give reasons for the following:
   a. Floods cause destruction of fertile farm lands found along river beds.
   b. Sedimentation and decantation is a rough and rapid process of purification of a liquid.
   c. Water to be supplied to a city is chlorinated.
5. Correct the following statements:
   a. Common salt is insoluble in water.
   b Rain water collected after a few showers contains dissolved impurities.

c. Crystals are imperfectly shaped and may contain impurities.
d. Evaporation is carried out in a laboratory to recover pure solvent from a solution.

6. Pick out the correct answer.
   a. This chemical is used to kill germs.
      i. sodium chloride ; ii. carbon dioxide; iii. potassium permanganate
   b. This substance is insoluble in water.
      i. silt; ii. salt; iii. sugar
   c. A pure form of this can be got by distillation.
      i. rock salt; ii. water; iii. milk
   d. This process ensures the removal of all the suspended impurities in a liquid.
      i. decantation; ii. evaporation; iii. filtration
   e. This is used by many people to get clear water for drinking purposes.
      i. water turbine; ii. home filter; iii. water cycle.

UNIT V *OUR UNIVERSE*

7. The planet earth

What are planets?

Are you in the habit of star-gazing? If so, you may have noticed what looks like a wandering star. You see innumerable stars fixed in their positions in the sky whereas the wandering star moves slowly as a speck of light among the fixed ones. If you watch carefully, you will see that this speck of light only 'blinks' whereas the fixed stars twinkle. If you are a really good observer, you will see one or more of such tiny, blinking specks of light moving across the sky. The twinkling specks of light are stars and the blinking, wandering specks of light are planets. The stars have light of their own whereas the planets borrow light and reflect it back into space. The stars appear to twinkle as they are very far from the earth. The planets reflect steadier light as they are relatively very near to the earth.

Our home, the earth, is one such planet which receives light from the sun and reflects it back into space, just as our moon does. Just as we get moonlight, an observer on the moon will get earthlight!

Position and size of planets

The sun and its family of nine planets and their moons constitute the solar system. Planets are dark globes which do not produce their own light. They reflect the sun's light. All of them move around the sun, each of them having a fixed orbit. Our planet earth is third from the sun, the first two being Mercury and Venus. Beyond planet earth are placed Mars, Jupiter, Saturn, Uranus, Neptune and Pluto.

There are also thousands of tiny planets found scattered between the orbits of Mars and Jupiter. These tiny pieces of rock are called asteroids or planetoids. These also travel in their own orbit round the sun. Of the other eight planets, those from Mercury to Uranus can be seen with the naked eye. Neptune and Pluto cannot be seen without a powerful telescope. As you have already learnt, we see Mercury and Venus only as morning and evening stars in the sky, as they appear just a little before sunrise or a little after sunset. This is because they are closer to the sun than planet earth.

Mercury, Venus, Earth and Mars are small, rocky balls with thin atmospheres whereas the giant planets Jupiter, Saturn, Uranus and Neptune each has an atmosphere thousands of miles deep! All that we see of them is the outermost part of their atmosphere! Pluto is small and is the outermost planet. Nothing much is known about it.

Our home planet

Earth, our home planet, is the only one that has all the factors necessary for life such as an atmosphere with oxygen, water, minerals essential for living things and a temperature suited for life activities. That is, the earth is not near enough to the sun to be too hot or far enough to be too cold. The earth is about 93 million miles or 150 million kilometres away from the sun. It receives a steady supply of heat and light from the sun which suits life on earth.

The earth is a fairly small planet, a ball made of rocks and metals. The distance around its middle, its circumference, is about 40,000 km and the distance straight through the centre, its diameter, is around 12,800 km. The tallest mountains about 9.6 km high, appear as tiny bumps on its surface when viewed from a spacecraft! The earth when viewed from the moon by astronauts and cosmonauts, looked like a blue, brightly lit, beautiful ball. Rockets and satellites are sent into space to study the earth's atmosphere which extends more than 1,600 km above its surface. The lower atmosphere is usually studied by means of balloons and aeroplanes to foretell weather conditions. Weather satellites are sent into space to study the ever-changing weather conditions in various parts of the world.

Nearly nine-tenths of the total volume of the earth's atmosphere is held by its gravity within ten miles of its surface. Beyond that distance, the atmosphere gradually thins out. Beyond 1,600 km, it is very thin.

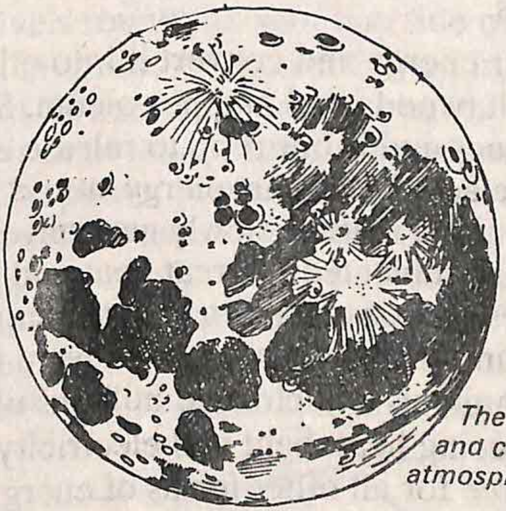
The moon, our natural satellite

The moon is our nearest neighbour in space. It is about 250,000 miles (400,000 kilometres) away from us. The diameter of the moon is a little over one fourth of the earth's diameter. (Its diameter is 3,456 km whereas that of the earth is about 12,800 km.) The moonlight that we receive is less than one-tenth of all the sunlight that strikes it and gets reflected.

Just like planet earth, the moon has mountains, plains and craters but it has no water or atmosphere. This is the reason why there is no life on the moon.

The moon travels around the earth in about four weeks. It is a natural satellite unlike the artificial ones that man has sent into space. A satellite is a body that travels around a planet.

The moon's gravity is about one-sixth that of the earth. This gravity is too weak to hold any atmosphere. That is probably the reason why the moon lacks an atmosphere. With the same effort which you need to jump one metre high on the earth's surface, you can jump six metres high on the surface of the moon!



The moon has mountains, plains and craters, but no water or atmosphere.

Sunlight, moonlight and earthlight

The sun is a star. It is a huge ball of fire, made of very hot gases. So it shines brightly and gives out heat and light of its own. The sun lights and warms the earth and the moon. Just like the other planets and their moons, planet earth and its moon reflect the light they receive from the sun. The light that is reflected by the earth is the earthlight which space travellers have seen and the light that the moon reflects is the moonlight which we all see. Earthlight and moonlight do not have much heat as they are reflected light.

Sunlight, the main source of energy

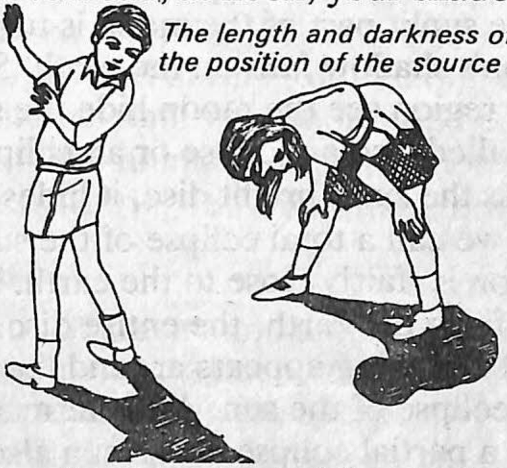
The sun produces enormous quantities of heat and light. The heat and light energy, called solar energy, that planet earth receives, is only a fraction of the energy the sun produces. The sun has been producing this energy for several thousand million years.

What fuel does the sun have which is capable of producing this enormous amount of energy? The sun is its own fuel. It consists mostly of a gas called hydrogen, which is under great pressure and heat deep inside the sun. Due to this enormous pressure and heat, hydrogen turns into another gas called helium. During this conversion, an enormous quantity of energy is released. This is solar energy which consists mainly of heat and light energy. The energy that is produced deep inside the sun escapes outward through its surface and reaches the planets.

Plants trap this solar energy and convert it into other usable forms of energy.such as starch, wood, coal and petroleum. Starch is the main fuel for living tissues and is burnt up to release energy which is required for various life activities. The energy stored in the plant body, as well as dead animal matter, slowly get converted into coal or petroleum when they are subjected to great heat and pressure. This gradual change requires millions of years for its completion. The fossil fuels, coal and petroleum, that we now dig out. were formed from organisms (plants and animals) which lived millions of years ago. These fuels are used for producing heat, light and electricity. Thus solar energy is the main source for all other forms of energy.

Lunar and solar eclipses

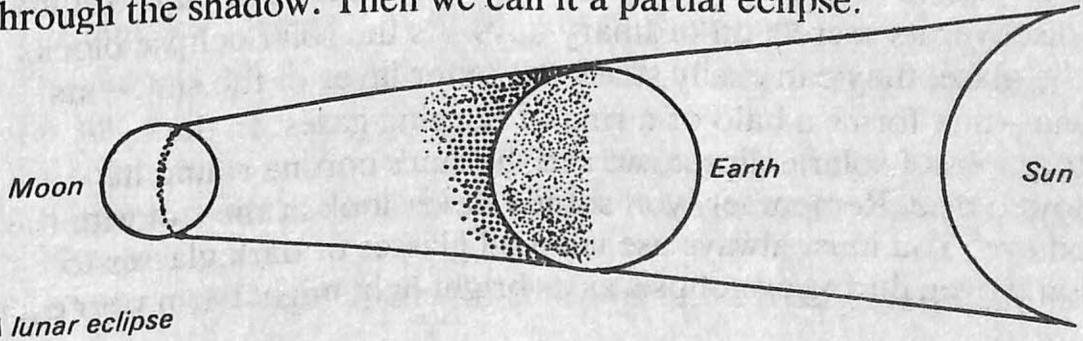
Any object that receives light naturally from the sun, or artificially from other sources of light, casts a shadow. You must have seen your own shadow falling in front of you or behind you according to the position of the source of light. A shadow may be long or short, dark or light, again depending upon the position of the source of light. When the sun is right overhead, at noon, your shadow will be darkest and shortest, almost hugging your heels. The shadow is longer in the morning or in the evening and it appears lighter. Just as all the lighted objects on the surface of the earth cast their shadows on other objects, the earth itself casts its shadow on the moon.



The length and darkness of a shadow depends on the position of the source of light.

Lunar eclipse

As the earth travels round the sun, one side of it receives light and it casts its shadow in space. As the earth travels, its shadow also moves along with it. When the moon, the earth's satellite, travels round the planet, it sometimes passes through this shadow region during the full moon phase. So, instead of receiving light directly from the sun, the moon gets dimmed or eclipsed by the shadow of the earth. A lunar eclipse or eclipse of the moon occurs. Sometimes the whole moon passes through the earth's shadow. Then we call it a total eclipse of the moon. At other times, only part of the moon passes through the shadow. Then we call it a partial eclipse.



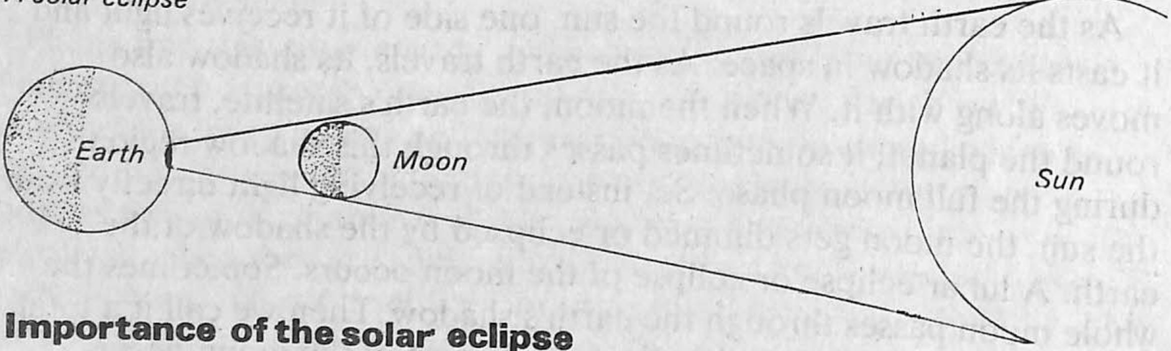
A lunar eclipse

Solar eclipse

Sometimes the moon casts its shadow on the earth when it is in the new moon phase. At this time it is positioned between the earth and the sun. Therefore, the sunlit part of the moon is turned away from the earth and the moon's shadow falls on the earth. So the people living within the shadow region see the moon hide the sun for a short duration. This is called a solar eclipse or an eclipse of the sun. As the moon moves across the sun's bright disc, it hides it completely for a few minutes. This we call a total eclipse of the sun. This can occur only when the moon is fairly close to the earth. When the moon is a little farther away from the earth, the entire disc of the sun is not hidden. Instead a bright ring appears around the eclipsed area. This is called an annular eclipse of the sun. Annular means ring-shaped. Sometimes we get a partial eclipse of the sun also.

We do not have a lunar or solar eclipse during every full moon or new moon phase because the moon's orbit is inclined to the earth's orbit. Eclipses occur only when the sun, the earth and the moon are in a straight line.

A solar eclipse



Importance of the solar eclipse

As the sun is very bright, astronomers find it very difficult to study and discover its secrets on ordinary days. As the solar eclipse blocks out the glare, they can easily study the outer layer of the sun — its corona—that forms a halo or a ring of burning gases. In the photographs of solar eclipses, we see the sun's corona round its shadowed disc. Remember, you should never look at the sun with the naked eye. You must always use smoked glasses or dark glasses to look at it even during an eclipse, as its bright light might harm your eyes.

Tides

If you happen to live close to the seashore, you may notice that the surface of the sea rises and falls twice a day, that is, tides are caused. During high tide (rise in sea level) huge rocks or stretches of sand on the seashore are submerged and during low tide (fall in sea level) they are completely exposed. Sometimes the shore will be littered with varieties of seaweed and shell animals brought ashore during high tide. As the water recedes (during low tide), these are left behind.

How are tides caused?

All bodies exert a force of gravity and tend to attract all other bodies towards themselves. You know that due to this force of gravity, all the heavenly bodies are able to maintain their respective positions. The moon (our satellite) and the sun, to a certain extent, through their forces of gravity draw the ocean waters towards themselves, causing tides. The effect of the moon's gravity on the surface of the sea is much more than that of the sun's gravity due to its nearness to the earth.

Spring tides and neap tides

When the sun, the moon and the earth are in a straight line (as on new moon days) we get very high tides. These are called spring tides. These are caused by the additional pull exerted by the force of gravity of the sun along with that of the moon on the surface of the sea. On other days the effect of the sun's force of gravity on tides is negligible. When the sun lies at right angles to the moon, the tides are not very high. These are called neap tides.

Things to remember

1. The stars twinkle as they have light of their own.
2. The planets 'blink' as they reflect the light which they receive from the sun.
3. The planets from Mercury down to Uranus can be seen with the naked eye. Neptune and Pluto can only be seen through a powerful telescope.
4. Mercury and Venus appear as morning and evening stars as they

are closer to the sun than the earth.

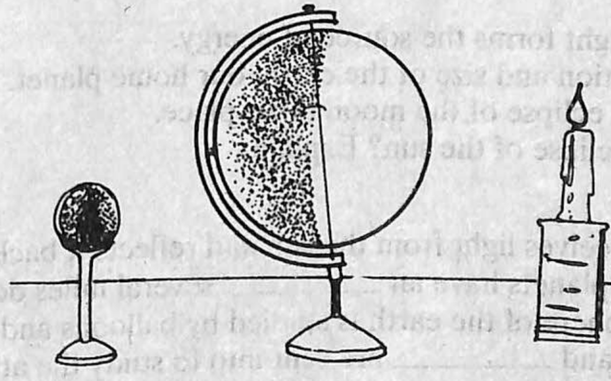
5. Mercury, Venus, Earth and Mars are small planets made of rocks and have thin atmospheres.
6. Jupiter, Saturn, Uranus and Neptune, each has an atmosphere thousands of miles deep. We see only the outermost part of their atmosphere.
7. The earth is the only planet which has all the factors necessary for life such as oxygen in the atmosphere, water, suitable temperature for life activities and minerals that are essential for living things.
8. The earth is not too close to the sun (scorching living things with its heat) or too far away (making it too cold for life).
9. The earth is about 93 million miles or 150 million kilometres away from the sun.
10. The earth's circumference is about 40,000 km and its diameter is around 12,800 km.
11. The tallest mountains, about nine km high, appear only as tiny bumps on its surface when viewed from a spacecraft!
12. The earth looks like a beautiful, blue ball to spacemen.
13. The earth's atmosphere extends upto 1,600 km above its surface. Beyond this it thins out.
14. Nearly nine-tenths of the total volume of the earth's atmosphere is held by its gravity, within ten miles from its surface. Beyond that distance, the atmosphere gradually thins out. Beyond thousand miles, it is very thin.
15. The moon is our nearest neighbour in space. It is 250,000 miles or 400,000 kilometres away from us.
16. The diameter of the moon is 3,456 km, a little over one-fourth of the earth's diameter.
17. The moon has no life as its gravity is too weak to hold any atmosphere. Its gravity is one-sixth that of the earth.
18. Sunlight is the main source of energy.
19. Plants trap this energy and convert it into other usable forms of energy.
20. A lunar eclipse occurs sometimes during the full moon phase,

when the earth comes between the moon and the sun and casts its shadow on the moon's surface.

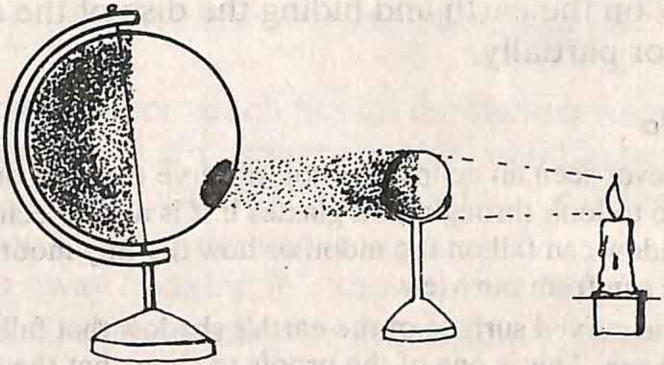
21. A solar eclipse occurs sometimes during the new moon phase, when the moon comes between the earth and the sun, casting its shadow on the earth and hiding the disc of the sun from us, either totally or partially.

Things to do

1. Have you ever seen an eclipse? If not, observe the next one which occurs, taking care to look through dark glasses if it is a solar eclipse. Observe how the earth's shadow can fall on the moon or how the tiny moon can hide the huge disc of the sun from our view.
2. Observe the curved surface of the earth's shadow that falls on the moon during a lunar eclipse. This is one of the proofs to show that the earth is spherical and not flat. Watch how the moon wanes and waxes during the course of an eclipse. Draw the various stages of the eclipse.
3. How does an eclipse occur? You can show this by a very simple experiment. Take a candle or an electric light with a stand. Use this as your sun. Take a small globe (the earth) and a rubber ball fixed on to a stand (the moon).
   a. To demonstrate a lunar eclipse: Keep the earth between the sun and the moon in the same plane. Adjust the distance so that you can see the earth's shadow falling on the moon — the ball. Slowly move the position of the ball, and see how the moon escapes from the shadow region.



   b. To demonstrate a solar eclipse: Keep the ball as close as possible to the globe, placing it between the source of light and the globe. Now you see the darker side of the ball or the moon (new moon phase). Keep your eye in line with the globe and the ball (the earth and the sun) and look at the source of light. You can see how the ball hides the light either partially of fully. Thus you can show how a partial or a total eclipse of the sun occurs!



Exercises

1. Answer briefly
   - a. How can you find out whether you are looking at a planet or a star?
   - b.Name the planets which can be seen with the naked eye.
   - c. Name the planets which are called morning and evening stars.
   - d. Which planets require the use of a powerful telescope for observation?
   - e. Which planets have a fairly thin atmosphere?
   - f. What is the special characteristic of the earth's atmosphere?
   - g. Which planets have an atmosphere several miles deep?
   - h. What do we use to examine the nature of our atmosphere?
2. Answer in detail:
   - a. Explain how sunlight forms the source of energy.
   - b. Describe the position and size of the earth, our home planet.
   - c. Describe how the eclipse of,the moon takes place.
   - d. What causes an eclipse of the sun? Explain.
3. Fill in the blanks:
   - a. A __________ receives light from the sun and reflects it back into space.
   - b. Each of the giant planets have an __________ several miles deep.
   - c. The lower atmosphere of the earth is studied by balloons and __________ Whereas rockets and __________ are sent into to study the atmosphere which extends beyond __________ miles.
   - d. We see moonlight from the __________, whereas when we go to the moon, we will be seeing __________
   - e. Any object which receives light casts a __________

f. Our shadow at noon will be the __________ and the __________.

g. If we jump one metre from the surface of the __________, we can actually jump __________ times higher with the same effort from the surface of the moon because the moon's gravity is six times __________ than that of the earth.

h. During a solar eclipse a total eclipse of the sun's disc takes place when the moon is fairly __________ to the earth. When it is a little __________ away from it, an annular eclipse takes place.

4. Give reasons for the following:

   a. If we want to look at the sun, we must use smoked glasses.
   b. Nearly nine-tenths of the earth's atmosphere is found within ten miles from its surface even though the total atmosphere extends beyond thousand miles!
   c. The moon, our satellite, has no atmosphere.
   d. We see only the outermost part of the atmosphere of Jupiter even when we view it through a telescope.
   e. Planet earth alone has life.

5. What are the following? Why are they called so?

   a. planetoids
   b. planet
   c. annular eclipse
   d. weather satellite
   e. earthlight

8. Our mineral wealth

What is rock? Where is it found?

Rock is the hard, solid part of the earth's crust. Normally, soil covers up the rocky bed of the earth's crust. You have learnt about layers of soil—topsoil, subsoil and bedrock. You have also learnt that soil itself is formed by the disintegration of rocks and is made up of tiny bits of rocks mixed with dead and decaying plant and animal matter. This is the reason why soil supports plant life as it contains the necessary nutrients in the form of minerals for its growth. Apart from the rocky areas that we find on the surface of the earth, rocks are found even beneath the oceans and under the ice-capped polar regions.

What are minerals?

The entire natural world is divided into three great kingdoms, the kingdoms of plants, animals and minerals. Of these, plants and animals are living but their bodies are built up by making use of non-living minerals. Except for water and mercury, all other naturally occurring minerals are solids.

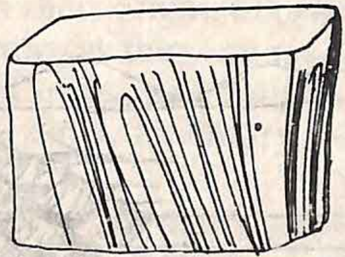
There are about 2000 known minerals of which only about 30 are found in large quantities in rocks which can be mined. They are called rock-forming minerals.

Feldspar, mica and quartz are minerals found in granite rocks. These are the most abundant of minerals found on the earth's crust. They are minerals containing silicon. Sand is an oxide of silicon. Quartz is also an oxide of silicon, but it is found in crystalline form. Next to silicon, carbon is the most widespread material. Calcite (calcium carbonate) is the most common amongst the minerals containing carbon. It is a transparent mineral.

Minerals found in rocks

Apart from minerals found in the soil that sustain plant life, rocks contain various important minerals which can be of great use to mankind.

Most rocks contain one or more minerals. Marble is a rock which contains only one mineral whereas granite has three. Minerals are found in the form of ores also.



Most rocks contain one or more minerals.

What is an ore?

An ore is a mineral or a rock which contains enough of a substance to be worth mining.

Types of ores

There are metallic and non-metallic ores. They occur in 'beds' or 'veins' mixed with other valueless minerals called the 'gangue'.

Gold, silver, platinum and copper are valuable metals which are found in their pure state in some of their ores. Others occur in a combined state. Rock salt, borax and graphite are some of the common non-metallic ores.

Geologists and palaeontologists

Geologists are scientists who trace the history of the earth by studying rocks. They discover and study the various mineral and oil deposits in the world.

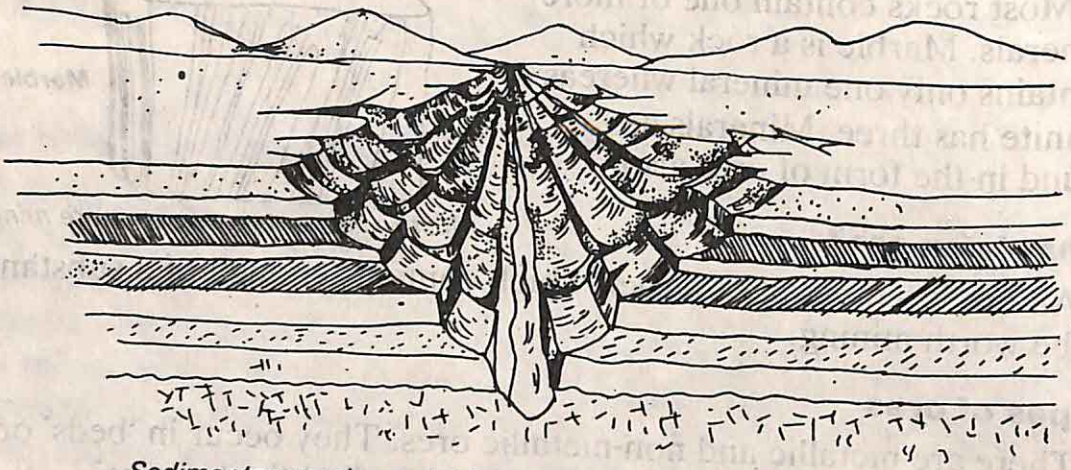
Palaeontologists are scientists who study 'fossils', which are the dead remains of plants and animals found imprinted in rocky beds, to learn about the kind of living organisms that existed millions of years ago on earth.

Types of rocks

Rocks are classified into three main groups according to the manner in which they are formed.

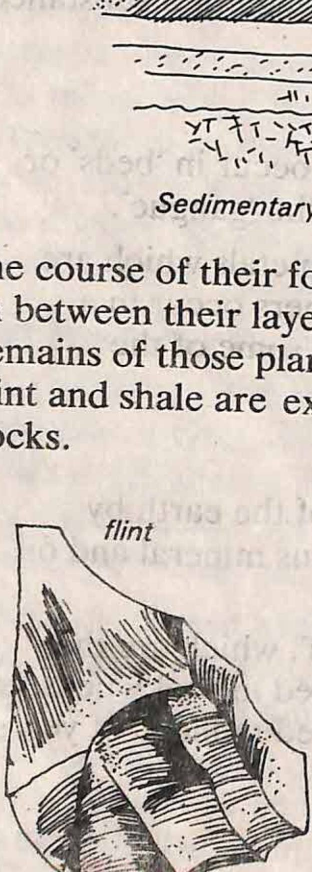
Sedimentary rocks

Sedimentary rocks are those which are laid down in layers by the action of the wind, running water (rivers and streams) or the sea. In

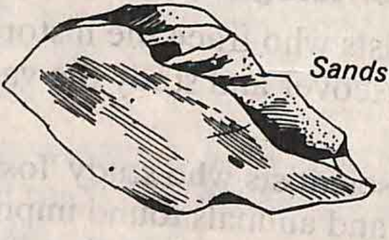


Sedimentary rocks are laid down in layers by wind and water.

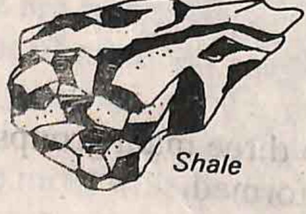
the course of their formation, they trapped many plants and animals in between their layers. They are formed partly from the fossil-remains of those plants and animals. Sandstone, clay, conglomerate, flint and shale are examples of sedimentary rocks. They are inorganic rocks.



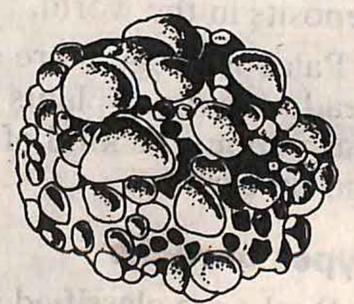
flint



Sandstone

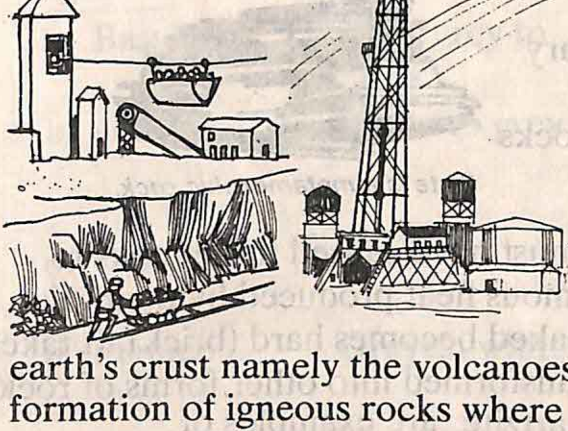


Shale



Conglomerate

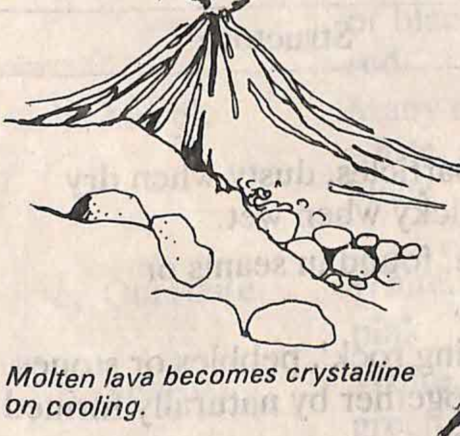
Coal is an organic rock formed from the submerged and buried forests whereas mineral oil or petroleum has been formed from the remains of animals and plants which got buried when a river deposited its silt in the sea or a lake. Thus coal and oil are always found in sedimentary rocks which are organic in their origin. Likewise, limestone rocks are also of an organic nature as they are made of shells or hard parts of animals of the sea. Corals are examples of such limestone rocks. Fossils are found in plenty in sedimentary rocks.



Coal and oil are found in sedimentary rocks which are organic in origin.

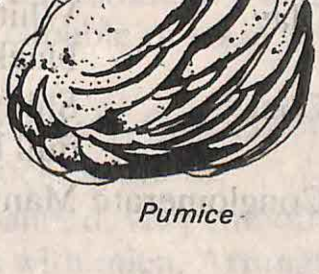
Igneous rocks

Igneous means 'fiery'. The interior part of the earth is made up of molten lava which comes to the surface through the weak parts of the earth's crust namely the volcanoes. Volcanic eruptions result in the formation of igneous rocks where the molten lava becomes crystalline on cooling. The Deccan plateau in peninsular India is covered by igneous rock called basalt.



Molten lava becomes crystalline on cooling.

Obsidian



Pumice

Granite

Granite is an example of deep-seated igneous rock. Granite is a hard rock. Fossils are not normally found in igneous rocks. Pumice and obsidian are also igneous rocks. Pumice is very light. It looks porous. As molten rock solidifies, gases escape piercing through it, making it porous. Obsidian is so glassy and brittle that it is called 'volcanic glass'.

Metamorphic rocks

The modified forms of sedimentary and igneous rocks are called metamorphic rocks. They are actually rocks which have changed their forms.

Slate is a metamorphic rock.

The occurrence of earthquakes must have caused these rocks to change their forms due to the enormous heat produced by them. For example, clay which is soft, when baked becomes hard (brick). It takes millions of years for rocks to get transformed into other forms of rock. Gneiss, marble, slate, schist and quartzite are examples of metamorphic rocks.

You can study the following table for the various properties of common rocks.

Rock	Colour	Structure
Sedimentary		
a. Clay	White, red, black, brown	Fine particles, dusty when dry and sticky when wet.
b. Coal	Shiny black to dull black	Brittle, found in seams or layers.
c. Conglomerate	Many colours	'Pudding rock', pebbles or stones held together by naturally formed cement.
d. Flint	Dark grey	Hard, breaks with a sharp edge; used for striking fire.
e. Limestone	White, grey	Forms thick beds containing fossils. Coral beds.

f. Sandstone	White, grey, yellow, red	Fine or coarse sand grains or quartz cemented together in beds.
g. Shale	Yellow, red, grey, green, black	Soft, fine particles, closely packed, splits easily; oil shale gives out oil on heating.
Igneous		
a. Basalt	Dark grey to black	Minute crystals, very closely packed. Covers Deccan plateau.
b. Granite	White to grey	Tightly arranged, medium to coarse crystals. Contains quartz, feldspar and mica.
c. Obsidian	Black	Glassy, non-crystalline, brittle (breaks easily). Volcanic glass.
d. Pumice	Greyish white	Light, glassy, with fine pores. Floats on water. Spongy form of volcanic glass.
Metamorphic		
a. Gneiss	Grey and pink or black and red	Coarse crystals arranged in bands. Some contains feldspar and quartz. Others contain mica.
b. Marble	Many colours—white, pink, black	Medium to coarse crystals, may be banded. Limestone in a crystalline shape is capable of taking high polish.
c. Quartzite	White, grey, pink	Hard and glassy. Consists of quartz in interlocking grains.
d. Schist	White, grey, green, black	Finely banded, very smooth, often sparkles with mica. Arranged in parallel layers.
e. Slate	Black, red, green, purple	Fine grains, closely packed, split into thin, smooth slabs.

Limestone is metamorphosed into marble. Shale is metamorphosed into slate.

Precious gems

Minerals and stones used in jewellery are called gems. The word gem comes from the Latin word 'gemma' meaning bud. Just as buds bloom into flowers, dull lumps of minerals are cut and polished into brilliantly glowing gems.

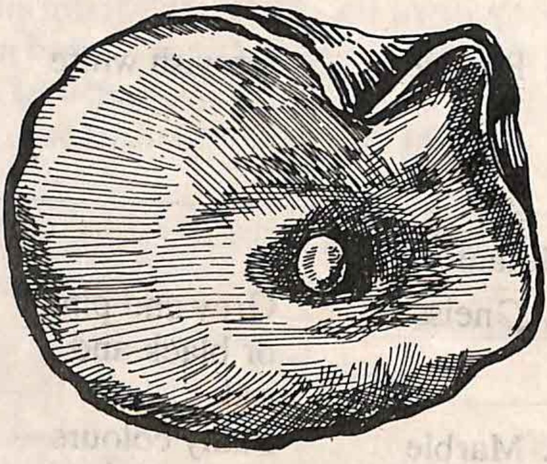
Diamond, ruby, sapphire, emerald, coral, pearl, cat's eye, opal, amethyst, garnet, moonstone, turquoise, jade, agate, bloodstone, aquamarine and amber are some of the precious gems. They are not all minerals or stones. Pearl is got from the pearl oyster, coral is got from coral animals and amber is got from the resin of fossil trees.

Sapphire

Ruby

Emerald

Diamond


Pearl

Commercially important minerals

Iron, copper, petroleum are some of the commercially important minerals. They are mined and suitably purified.

Coal and petroleum

Coal and petroleum are fossil fuels. You have already learnt how they are formed.

Coal is a brittle, black or brown rock. It is one of the most useful rocks dug from mines and it is often called the 'black diamond'. By burning coal, enormous heat energy is produced which is made use of in factories and for producing electricity.

Hundreds of chemical goods are produced from coal such as perfumes, plastics, nylons, aspirin, artificial rubber and beautiful colour dyes for clothes.

Petroleum is a liquid mineral which is found in abundance deep in the earth, even under the sea. It is called "black gold" because of its commercial value. The various products of petroleum such as diesel, high-speed diesel, petrol, kerosene, gasoline, fuel oils, lubricants, jet fuel, asphalt and many petrochemicals are commercially very useful. L.P.G. (Liquefied Petroleum Gas) is a common cooking gas now. Many insecticides and pesticides are petrochemicals.

As coal and petroleum are commercially very important, a country (like the United States) which produces them in abundance along with iron ores can become the most industrialised country in the world.

Soil

You know that soil covers most of the land surface of the earth. It is made up of rock and mineral particles of various sizes and textures mixed with living things and their dead remains. It is shallow in some places and deep in others. Soil supports all kinds of plant life. As soil is one of the most important resources, great efforts are made to conserve soil.

Soil fertility

Plants obtain much of their food from the soil. Therefore it is necessary that the chemicals that provide these foods be found in the soil. If they do not exist in the soil, they must be added to it in the form of manures and fertilisers. Manures are naturally obtained whereas fertilisers are manufactured in factories.

Minerals essential for the growth of plants

Sodium, potassium, calcium, phosphorus, magnesium, iron and chlorine are essential for the growth of all living things. Apart from these they need carbon, hydrogen and oxygen to build up the parts of their bodies. Plants need these ten minerals for their growth and animals get them from plants either directly or indirectly.

Manures and fertilisers

Manure is any substance which is added to the soil to make it more fertile. Manures can be both natural and commercial. The commercial manures are called fertilisers.

Farm manures consist of waste materials from farm animals such as dung and urine. They are important as they contain all the necessary minerals for the growth of plants such as nitrogen, phosphorus and potash.

The soil to be enriched should be tested for its mineral composition and suitable fertilisers should be mixed with farm manure and applied. Farm manure, apart from enriching the soil, helps it to retain warmth and moisture which are essential for the growth of plants.

Green manures: Plants like bean and pea possess legumes or pods which are their fruit. Such plants are called leguminous plants. Their plant body is rich in nitrogenous material. After the pods are harvested, the plant is ploughed into the field to enrich the soil. In our country, the leaves of leguminous trees such as gliricidia and agastya are also used as green manures.

'Complete fertilisers' are nowadays available. They contain all these necessary compounds in the proportions in which plants in general need them.

Kinds of fertilisers

The chief kinds of fertilisers are calcium, nitrogen, phosphorus, potassium and sulphur.

Calcium is obtained in the form of wood ash, limestone and lime.

Nitrogen is obtained in the form of bone meal, sodium nitrate, potassium nitrate, urea, ammonium sulphate and ammonium phosphate.

Phosphorus is obtained in the form of bone ash, ammonium phosphate and super phosphate.

Potassium is obtained in the form of potash, potassium chloride and potassium nitrate.

Sulphur is obtained in the form of ammonium sulphate and super phosphate.

Fixation of nitrogen

Natural means: Air is a mixture of gases and its main constituents are nitrogen and oxygen, found in the ratio of 4 : 1 by volume. This atmospheric nitrogen is made use of by certain bacteria found in the root nodules of leguminous plants. They prepare salts of nitrogen like nitrites and nitrates. After the legumes are harvested, the plant bodies with the root nodules are ploughed into the field as green manure. The root nodules are left in the soil to continue their 'nitrogen fixing' activity, that is, production of nitrites and nitrates from atmospheric nitrogen. These enrich the soil for future crops.

Crop rotation

If farmers continue growing the same variety of crops season after season, the soil will get poorer and poorer in the minerals which are required by that crop. So the yield will be affected if they fail to replace these minerals. Instead, farmers cultivate leguminous plants alternating with paddy or any other cereal crop so that the salts of nitrogen required by the cereals can be fixed by the bacteria in the root nodules. This method of maintaining soil fertility is called crop rotation.

Artificial means of nitrogen fixation: In fertiliser factories, ammonia is manufactured using atmospheric nitrogen and hydrogen from water. Ammonia is a gas which consists of nitrogen and hydrogen. From ammonia, the fertilisers such as ammonium nitrate, ammonium phosphate, ammonium sulphate and urea are manufactured.

Thus atmospheric nitrogen can be 'fixed' or made use of by both natural and artificial means for the cultivation of crops.

Things to remember

1. Rock is the hard, solid part of the earth's crust.
2. The entire natural world is divided into three kingdoms, the

kingdoms of plants, animals and minerals.

3. An ore is a mineral or a rock which contains enough of a substance worth mining.
4. Both metallic and non-metallic ores are found on the earth's crust. They occur in beds or veins mixed with other valueless minerals called the gangue.
5. Geologists trace the history of the earth by studying rocks.
6. Palaeontologists study fossils to learn about the kind of living organisms that existed millions of years ago on the earth.
7. Rocks are of three types. They are sedimentary, igneous and metamorphic rocks. Organic rocks such as coal and limestone are also sedimentary rocks.
8. Fossils are found in plenty in sedimentary rocks.
9. Sedimentary rocks are those which are laid down in layers by the action of the wind, running water (rivers and streams) and the sea. Sandstone, clay, sand and shale are examples of sedimentary rocks.
10. Volcanic eruptions result in the formation of igneous rocks where the molten lava becomes crystalline on cooling. Basalt, granite, pumice and obsidian are some igneous rocks.
11. The modified forms of sedimentary and igneous rocks are called metamorphic rocks. Gneiss, marble, slate, schist and quartzite are examples of metamorphic rocks. Limestone becomes marble. Shale becomes slate.
12. Minerals and stones used in jewellery are called gems. The dull lumps of minerals are cut and polished into brilliantly glowing gems. Diamond, ruby, sapphire and emerald are some precious gems.
13. Iron, copper, coal and petroleum are commercially very important.
14. Soil fertility is maintained by adding manures and fertilisers.
15. Farm manures and green manures are naturally obtained. whereas fertilisers are manufactured.
16. Urea, ammonium nitrate, ammonium sulphate, super phosphate, sodium nitrate, potassium nitrate and potassium chloride are some fertilisers used by us.

17. Fixation of nitrogen is done both naturally and artificially so that atmospheric nitrogen is converted into useful nitrites and nitrates.
18. Bacteria found in the root nodules of leguminous plants are good nitrogen fixing agents.
19. Crop rotation is done to maintain soil fertility.
20. In fertiliser factories atmospheric nitrogen is converted into ammonia.

Things to do

1. If you happen to see mountain roads being constructed, look at the newly cut layers of rocks. Make a note of their colour and shape.
2. Visit ancient churches or palaces. Look at the beautiful chandeliers. They are mostly made of crystalline quartz.
3. Melt some sulphur in a porcelain dish and pour it into a moist filter paper cone. The molten sulphur cools down quickly into a solid, yellow mass. Break this sulphur cone. You will find bright, shiny crystals of sulphur. Molten lava from the volcanoes must have cooled down in the same manner to form crystalline, igneous rocks
4. Pour hot molten sulphur into a cup of water. It solidifies into a porous mass as bubbles of air escape through it. Pumice must have been formed in the same manner when hot gases bubbled through it as it cooled and solidified.

Exercises

1. Answer briefly:
   - a. What is a rock?
   - b. What is an ore? What are the two types of ores?
   - c. Name the three types of rocks?
   - d. What are gems?
   - e. Name the ten important minerals needed by living things.
   - f. Who are geologists?
   - g. Who are palaeontologists?
   - h. What is 'black diamond'?
   - i. In what manner are coal deposits found?
   - j. What is 'black gold'?
   - k. Name the chemicals produced from coal.
   - l. Name the useful products of petroleum.

2. Answer in detail:
   a. Describe how sedimentary rocks are formed.
   b. Why are some igneous rocks crystalline in nature?
   c. Describe the structure of granite and calcite.
   d. How do precious gems get their names?
   e. Name the fossil fuels. Describe where they are found and how they are used.
   f. How can you differentiate manures from fertilisers?
   g. How does crop rotation maintain soil fertility?
   h. What is fixation of nitrogen? How is it carried out in the root nodules of leguminous plants?

3. Match the following:

a. slate	valueless minerals found in rocks
b. gangue	fossil fuel
c. pumice	found even under the sea
d. ruby	green manure
e. coal	metamorphic rock
f. petroleum	igneous rock
g. quartz	fertiliser
h. gliricidia	precious gem
i. root nodules	shiny and crystalline
j. super phosphate	fixation of nitrogen

4. Give reasons for the following:
   a. The word gem is derived from the Latin word 'gemma'.
   b. Slate, though a metamorphic rock can be chipped off in layers.
   c. Leguminous plants are ploughed into the field after the pods are harvested.
   d. Farm manure contains large amounts of urea.
   e. Marble is a metamorphic rock.

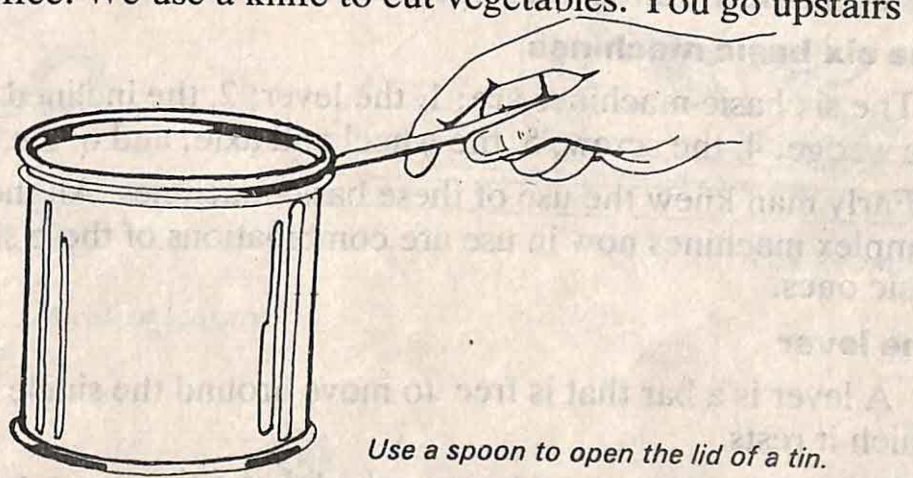
5. Identify the following:
   a. conglomerate
   b. gneiss
   c. flint
   d. obsidian
   e. pumice
   f. marble
   g. slate

UNIT VII *FORCE, WORK AND ENERGY*

9. Simple machines

Are you aware of the fact that all of us are making use of a number of simple machines in our everyday life?

Early in the morning, we use a spoon to open the lid of the sugar tin to prepare coffee. We use a knife to cut vegetables. You go upstairs climbing the stairs. You sharpen your pencil using a sharpener. You draw water from a well, using a pulley or a wheel and an axle. You play on the see-saw in the evening. You travel by bus or car to visit your friends. All of us do similar things using simple machines, without actually being aware of these machines.



Use a spoon to open the lid of a tin.

What is a machine?

A machine is any tool or device used to help us do work. We now live in a machine age. We make use of simple and complex machines to make work easier. A complex machine is made up of several simple machines put together.

Let us further explain the term 'machine'. A machine is a tool or a device which, by applying force, a. makes work easier; b. changes the direction of force; or c. increases the speed with which work is done.

Do you know that even a cave man used a simple machine? In order to close the entrance to his cave with a huge boulder, he used a tree branch and a smaller piece of rock to shift the position of the boulder and move it to block the entrance. He probably accomplished this by resting the tree branch on the smaller piece of rock, pushing the end of the branch under the boulder and pressing down on the branch!

You can imitate his action if you move something heavy with a crowbar or a long stick instead of a tree branch. The crowbar or the stick is now used as a simple machine or a simple lever to make work easier. There are altogether six types of simple or basic machines in use.

The six basic machines

The six basic machines are: 1. the lever; 2. the inclined plane; 3. the wedge; 4. the screw; 5. the wheel and axle; and 6. the pulley.

Early man knew the use of these basic machines. All the complex machines now in use are combinations of these six basic ones.

The lever

A lever is a bar that is free to move around the single point on which it rests.

When you use a spoon to open the lid of a tin, you actually make use of a lever. You rest the spoon on the tin, insert the handle under the lid and press on the other side by applying force.

The point on which the spoon rests is called the 'fulcrum', the lid of the tin to be opened is the 'load' or 'resistance' and the force you apply is the 'effort'.

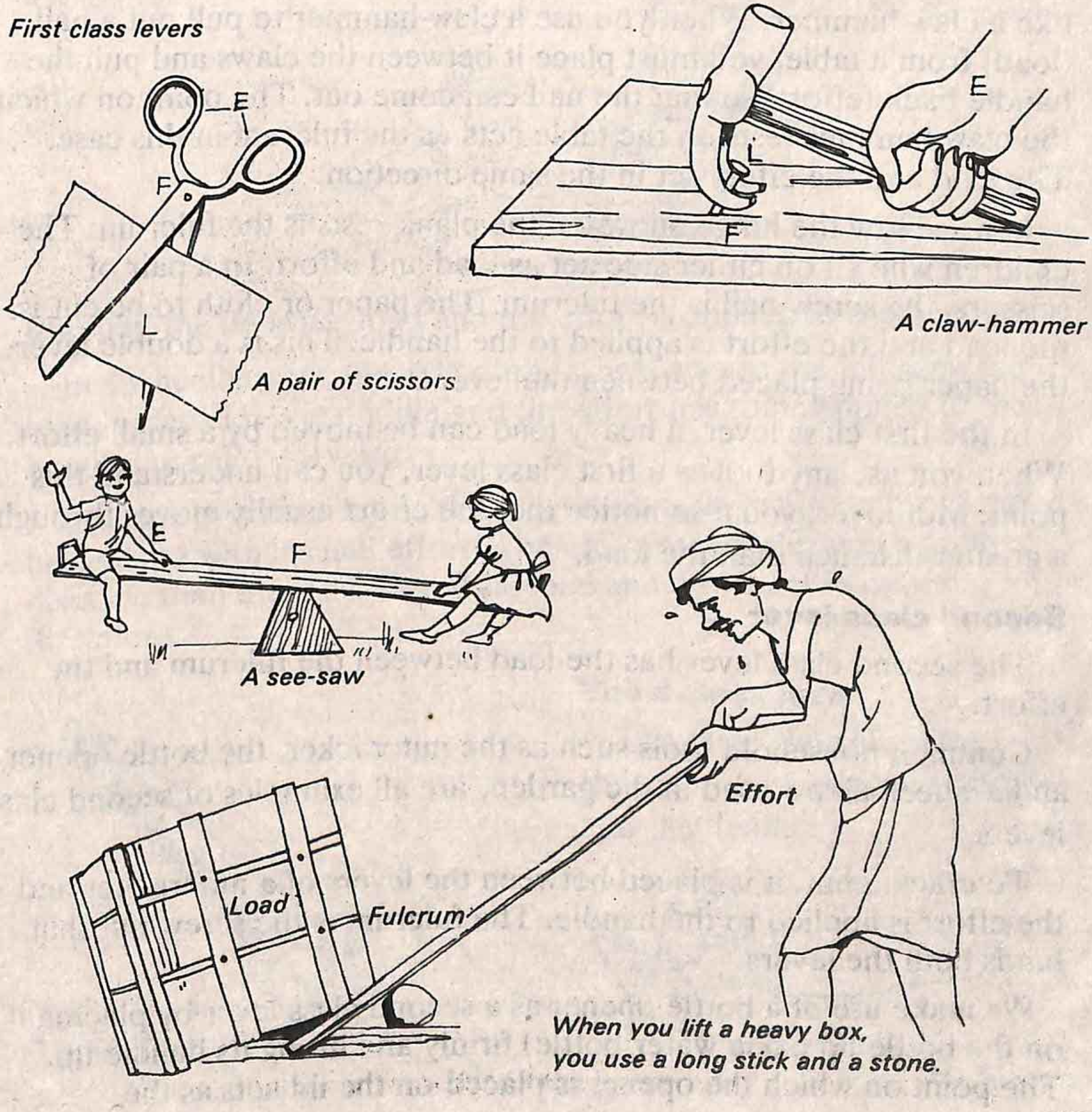
When the cave man used a tree branch and a small piece of rock to shift the boulder, he rested the tree branch on the small stone, using that single point on which it rested as the fulcrum. The boulder offered resistance and was the load and the force exerted on the other end of the tree branch served as the effort.

Types of levers

There are three classes of levers. They are classified according to the relative positions of the effort, the fulcrum and the load (resistance).

First class lever

The first class lever has the fulcrum between the load and the effort. Examples of first class levers are the cave man's tool (the tree branch), your kitchen tool (the spoon), your gardening tools (the crowbar and the long stick), your hand-work tool (a pair of scissors), your playground equipment (the see-saw) and a tool in your tool box (the claw-hammer).


First class levers

A pair of scissors

A claw-hammer

A see-saw

When you lift a heavy box, you use a long stick and a stone.

When you lift a heavy box or a stone, you use a long stick and a stone to act as the first order of lever. Where will you place the stone to act as fulcrum? Why do you make use of a long stick; why not a short one?

If you place the stone (the fulcrum) as close to the load as possible, lifting the load will be easier as less effort will be required. A longer stick also reduces the effort required.

A lever need not always be straight. Sometimes a lever is curved like a claw-hammer. When you use a claw-hammer to pull out a nail (load) from a table, you must place it between the claws and pull the handle back (effort) so that the nail can come out. The point on which the claw-hammer rests on the table acts as the fulcrum in this case. The load and the effort act in the same direction.

In a see-saw the hinge on which the plank rests is the fulcrum. The children who sit on either side act as load and effort. In a pair of scissors, the screw-nail is the fulcrum. The paper or cloth to be cut is the load and the effort is applied to the handle. This is a double lever, the paper being placed between the levers.

In the first class lever, a heavy load can be moved by a small effort. When you use any tool as a first class lever, you can understand this point. Moreover, you also notice that the effort usually moves through a greater distance than the load.

Second class lever

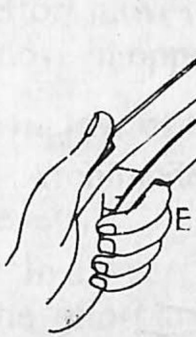
The second class lever has the load between the fulcrum and the effort.

Common household tools such as the nutcracker, the bottle opener and a wheelbarrow used in the garden, are all examples of second class levers.

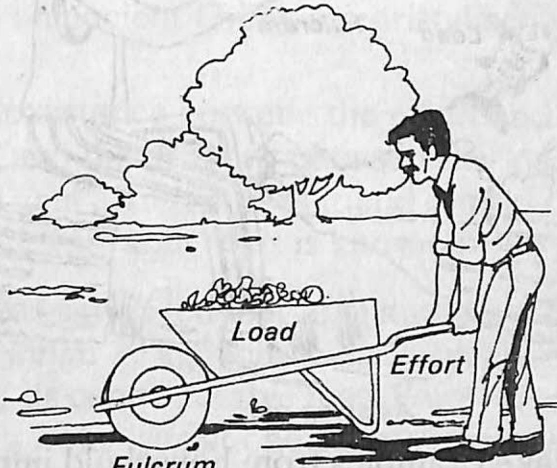
To crack a nut, it is placed between the levers of a nutcracker and the effort is applied to the handle. The fulcrum is the screw nut that binds both the levers.

We make use of a bottle opener as a second class lever by placing it on the bottle lid (soda water bottle) firmly and lifting its handle up. The point on which the opener is placed on the lid acts as the

Second class levers



A nutcracker



A wheelbarrow

A bottle opener

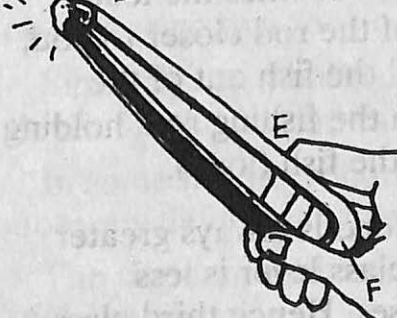
fulcrum, the lid is the load and the effort is applied to the handle.

In a wheelbarrow, the axle of the wheel acts as the fulcrum, the load is placed in the middle and the effort has to be applied to the handles to roll it forward.

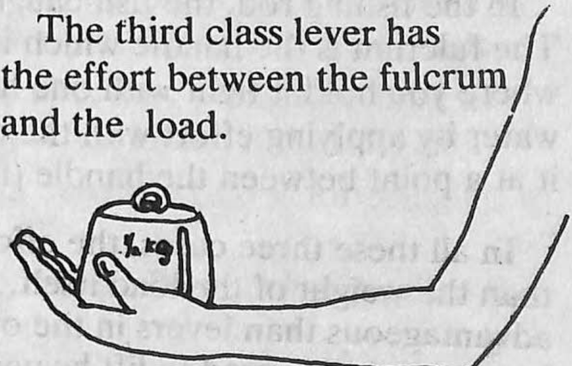
Like the first class lever, the second class lever also helps to move a heavy load with a small effort. The effort moves through a greater distance than the load. Here, the load and effort act in opposite directions.

Third class lever

The third class lever has the effort between the fulcrum and the load.

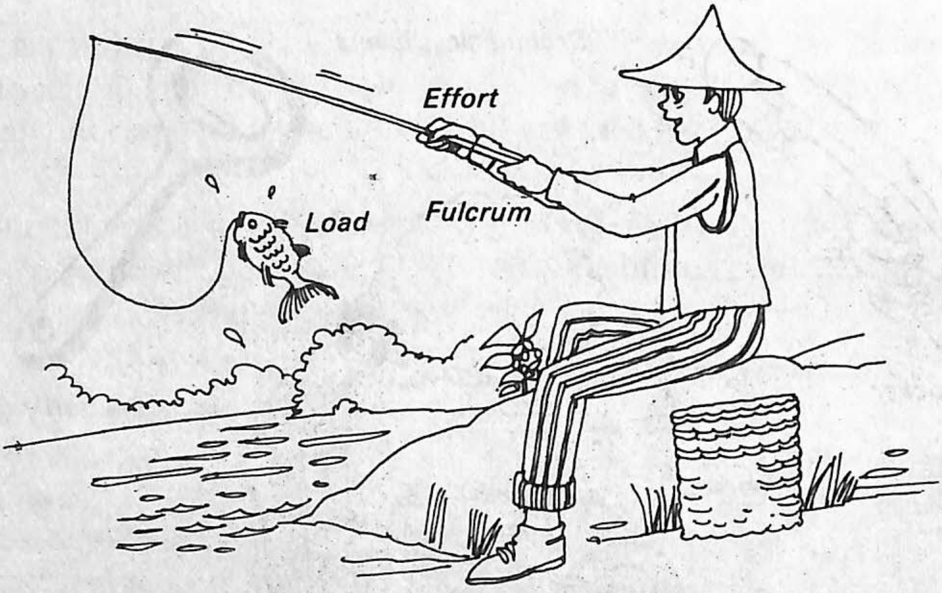


A pair of tongs



Third class levers

The human arm



A fishing rod

Here again we can take examples from household implements—a pair of tongs, used for removing hot things like live charcoal from a fire or a hot cloth from boiling water.

The human arm and a fishing rod are also examples of third class levers.

With a pair of tongs, the load is held between the two arms and the force is applied on both the arms in the middle. The U-bend of the tongs acts as the fulcrum.

In the case of our arm, the load to be lifted is placed on the hand, the shoulder or elbow joint acts as the fulcrum and the muscular force acts as the effort.

In the fishing rod, the fish caught on the hook becomes the load. The fulcrum is the handle which is at the end of the rod closer to you, where you hold it tight with one hand. You pull the fish out of the water by applying effort with the other hand on the fishing rod, holding it at a point between the handle (fulcrum) and the fish (load).

In all these three cases, the effort to lift the load is always greater than the weight of the load itself. So the third class lever is less advantageous than levers in the other two classes. Hence third class levers are never used to lift heavy objects. But in these levers, the effort moves a shorter distance than the load and load and effort move in opposite directions.

The law of levers

Archimedes, an ancient Greek scientist,discovered the usefulness of levers.

In a lever, the distance between the effort and the fulcrum is called the 'effort arm' and the distance between the load and the fulcrum is called the 'load arm'. Archimedes found out that: load × load arm = effort × effort arm. This is known as the law of levers.

Example: A see-saw is ten feet long and the two children, A and B, who play on it, weigh 20 kg and 25 kg respectively. The fulcrum of the see-saw is in its centre, at five feet. For perfect balance, if child A (effort) weighing 20 kg sits at one edge of the see-saw, so that the length of the effort arm is five feet, the other child B (load) should sit just four feet from the fulcrum on the other side, so that $20 \times 5 = 25 \times 4$. This is the law of levers. This is true for all levers.

From this example we can understand that by using less effort but operating from a greater distance, we can lift up a heavy load, which is closer to the fulcrum. By keeping the load arm as short as possible and increasing the length of the effort arm, we can lift a heavy load with little effort!

The inclined plane (the slope)

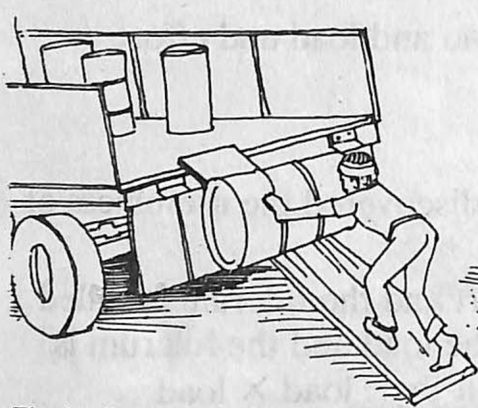
Have you seen how huge barrels of oil are loaded into a lorry or unloaded from it? The labourers use the rear framework of the lorry as a slope so that they can roll the heavy load up or down the slope!

Similarly, on a building construction site, long planks are used as slopes for the labourers to carry heavy loads in and out of the site.

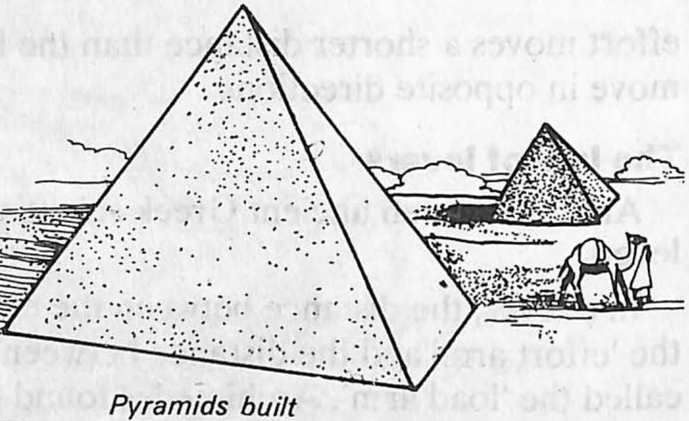
In some houses you may have seen a cemented slope for bringing a motor-cycle on to the verandah!

The slope undoubtedly makes work easier. This device is called the 'inclined plane'.

Now you can understand how the Egyptians must have built their



The inclined plane is used to load a lorry.



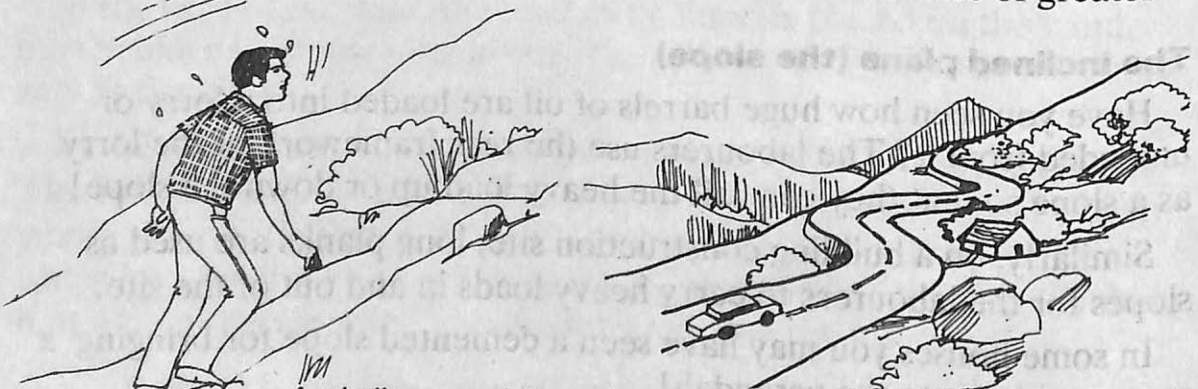
Pyramids built with the help of inclined planes

huge pyramids in ancient days when modern machines were not available. They must have known the principle of the inclined plane to achieve this feat!

A slide in your school games field or a park, the winding mountain roads, the winding of an ordinary staircase—all these are examples of the inclined plane.

How can we make work easier by using an inclined plane?

In your own house or in your school, you may find climbing up one particular stairway much easier than another. Look at both of them carefully. Which is more inclined and which is steeper? The one which you climb up easily is more inclined while the other one is very steep and hence is difficult to climb. So we build staircases of greater



A winding mountain road makes the ascent easy.

length than height with many shallow steps. So also, we have winding roads on mountains. Though we have to travel a longer distance to climb up, the work is made easier than if there was a steeper road of less distance!

Even slides in playing fields usually have a much greater length than height so that it is safe to slide down the plane.

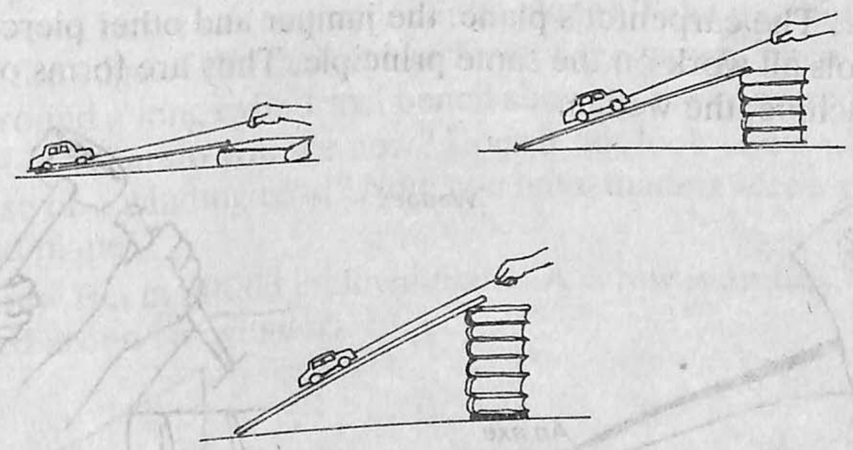
Now you know that the greater the length of an inclined plane, the easier the work.

More examples of the inclined plane

Nowadays, huge cities have fly-overs to reduce the traffic problem. They are built high above the existing roads in the form of an inclined plane, keeping the length of the plane as long as possible for the motorists to have a safe, gradual climb on the slope. Railway over-bridges are also of this type.

To demonstrate the advantage of using an inclined plane

You need a pile of books, a broad foot ruler, an elastic band and a toy car or any toy roller for this purpose.



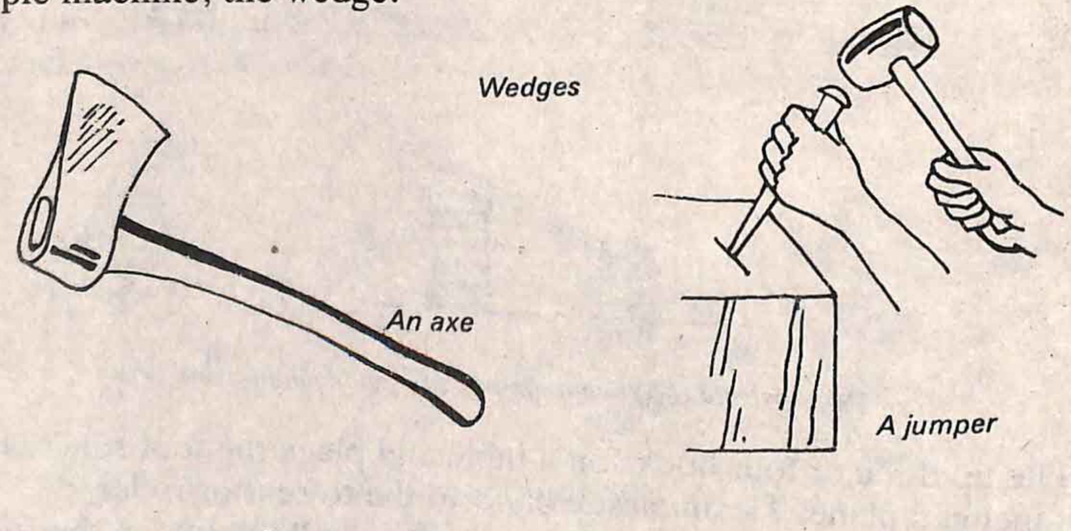
Demonstrate the advantage of using an inclined plane.

Pile up three or four books on a table and place the foot ruler as the inclined plane. Tie an elastic band to the toy car or roller. Measure the length of the elastic band. Then pull the toy up the foot ruler and note how long the elastic band stretches. Measure this length. Then increase the height of the inclined plane by placing more books on the pile. Pull the toy once again up the ruler. Do you find the work easier now than before? Certainly not. You know that you are now using a greater force to pull the toy up the plane and therefore the elastic band stretches more than before. This length, if measured, is found to be more than the previous length. If you lift the toy straight up, then the elastic band stretches to its maximum extent.

This experiment demonstrates the use of an inclined plane, where there is an advantage only if the length of the plane is much greater than its height. In any devise that we use, the length of the plane should be as great as possible and the height of the plane should be as small as possible to derive the maximum advantage. This is the law of the inclined plane.

The wedge

You make use of a knife to cut an apple into two. We use knives to cut vegetables and fruit. You use a needle for your needlework. A woodcutter uses an axe to split logs of wood. He also inserts into the cleft of a log a conical piece of iron on which he hammers to split the log further. The carpenter's plane, the jumper and other piercing and cutting tools all work on the same principle. They are forms of a simple machine, the wedge.



Wedges

An axe

A jumper

What is a wedge?

If you put two inclined planes together back to back, you have made a wedge!

The advantage of using a wedge

Imagine how annoying it is when the kitchen knife becomes blunt! Can you stitch with a blunt needle? Can a carpenter's plane be used without a blade? Can a dull jumper make a hole in a wall? Now you understand the advantage of using a wedge—a sharp machine—for all these purposes.

The screw

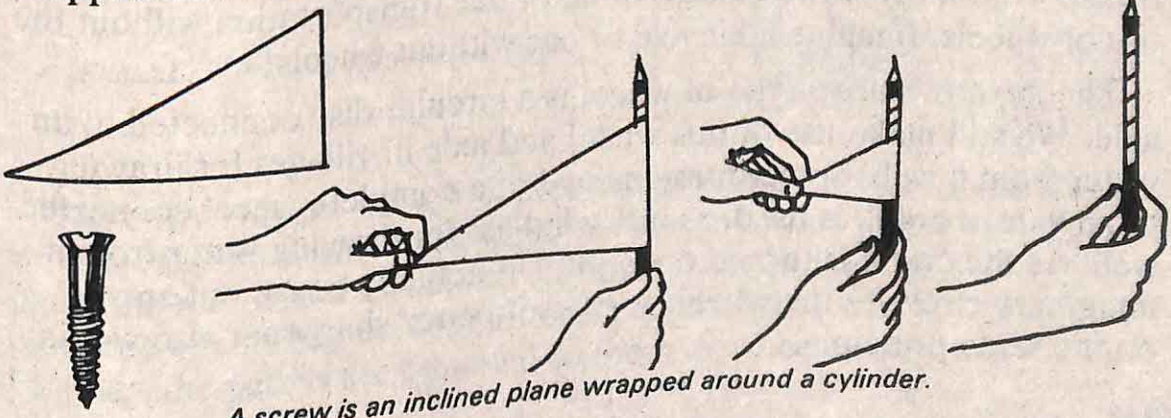
The spiral stairway which you use to go up a tower or a tall building is a giant screw. You know that the winding mountain roads are giant inclined planes. Do they not resemble winding stairways? So they are also giant screws.

Let us see how we can show that a screw is only a modified inclined plane.

To make a screw

Take a piece of paper and cut it into a square. Draw a line joining two opposite corners of the square. Cut the paper along this line. Now you get two bits, each one an inclined plane! Take a colour pencil and colour the edge of the inclined surface of the paper. Then wrap this paper round a long cylindrical pencil showing the coloured surface outside it. What do you see now? Does it not look like a winding staircase or a winding road? Now you have made a screw out of an inclined plane!

A screw is a modified inclined plane. A screw is an inclined plane wrapped around a cylinder.



A screw is an inclined plane wrapped around a cylinder.

Pitch of the screw

When a screw is turned round completely once, it moves through a distance equal to the space between two successive screw threads. This distance is called the pitch of the screw. It is easier to drive a screw with a smaller pitch into a piece of wood than one with a bigger pitch.

Nails and screws

If we nail two pieces of wood together, we can easily pull them apart. If we use a screw nail instead, we see that they are held fast.

Uses of screws

We make use of screw nails to join two pieces of wood or metal. They are very useful in making furniture, in fixing hinges to doors and windows and in fixing handles to metal objects.

Nuts and bolts have screw threads. The tops or lids of bottles and flasks have screws. The screw jack used in an automobile workshop is an example of this kind of simple machine. It is used for raising a car to change a tyre or for any repair work. The stools used by pianists, the executive's chair or the chair in a dentist's clinic are more examples of screws.

Wheel and axle

The ancient Egyptians used cylindrical logs of wood under wooden planks to roll heavy stones up an inclined plane to build their pyramids. Primitive men also knew the advantage of using logs of wood to move heavy objects. These logs of wood must have been the earliest rollers that man used. Wheels replaced rollers for transportation. Now we cannot think of our transportation without the use of wheels. Imagine a bicycle or car without wheels!

The most primitive type of wheel is a circular disc connected to an axle. We still make use of this wheel and axle in villages for drawing water from a well. Sometimes, instead of a complete wheel connected to an axle, a crank is used, as in a windlass for drawing water from a well. As the crank is turned once fully, it actually traces out an imaginary circle — the wheel. A type of pencil sharpener also works on the same principle.

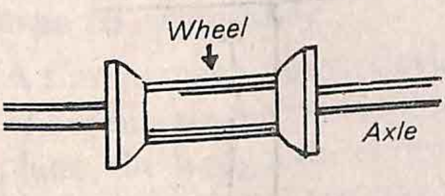
The modern wheel is constructed with cross-bars in order to make it stronger.

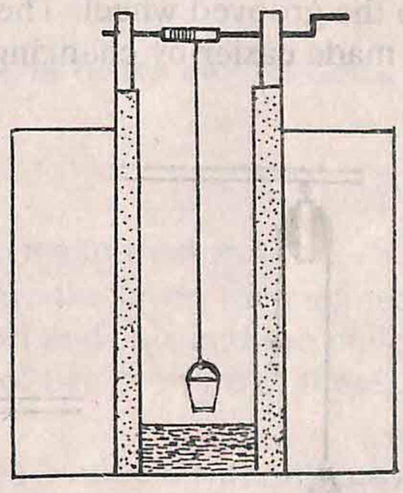
Unless a wheel is combined with another wheel or axle, it cannot be made to work as a machine. The axle is fastened rigidly to the wheel so that they both turn together.

A wheel and axle is a simple machine consisting of a wheel or a crank attached to an axle.

Let us see how a wheel and axle works to our advantage.

When we turn the wheel once completely, the axle also turns once as they are attached to each other. If the circumference of the wheel is four times more than that of the axle, we can get work done by using just one-fourth of the effort. Therefore, in a windlass with a circular wheel (instead of a crank) we have to pull the rope through four times the distance through which water from the well actually has to be lifted. (To lift a bucket of water through one metre we will have to pull the rope through four metres.) But we will use just one-fourth the effort to do the work. (If the load is 8 kg the effort will be equal to 2 kg.)





A windlass for drawing water from a well.

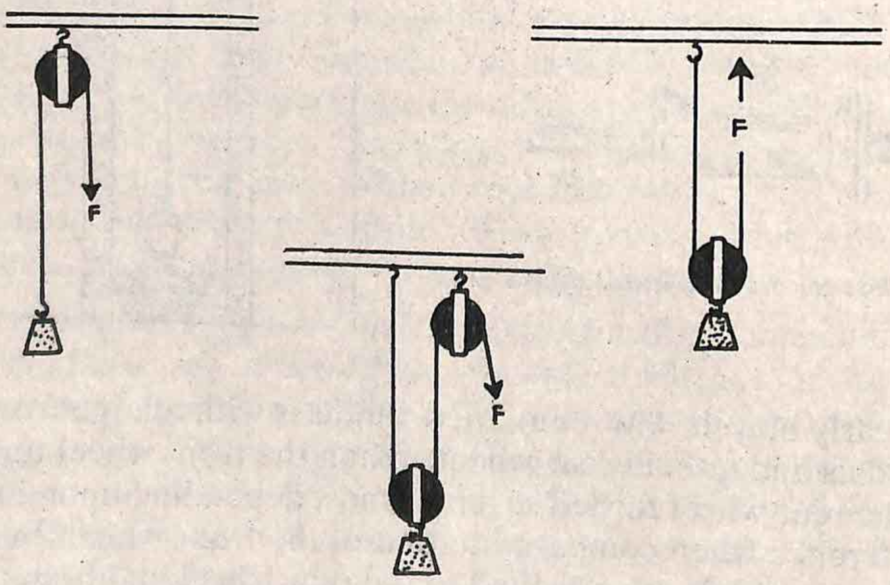
The early bicycle was a modified windlass with a large front wheel with pedals and a small rear wheel. When the front wheel turned once, the rear wheel turned several times, depending upon its circumference when compared to that of the front wheel. In modern bicycles, the pedals are attached to the rear wheel and both the wheels are of the same size. The pedals are fastened to a large notched wheel, connected to a smaller notched wheel in the rear wheel of the bicycle by a metal chain. When the larger notched wheel with the chain and the pedals is turned once, the rear one turns several times, turning the rear wheel along with it. Thus a simple wheel and axle becomes a complex machine.

More examples of the wheel and axle

The steering wheel of a motor car, an egg beater, a door knob, a motion picture reel the gears of automobiles (toothed wheels that engage each other), a coffee grinder, the wheel of a tailoring machine are all examples of the wheel and axle.

The pulley

A pulley is a grooved wheel over which a rope passes. A rope or a chain is used to lift heavy loads using a pulley. It is used mainly to change the direction of the force applied. That is, instead of lifting the load up against gravity, it is attached to a rope and is pulled down through the grooved wheel. The force applied is the same, but the work is made easier by changing the direction of the force.



The pulley is used mainly to change the direction of the force applied.

Pulleys are of different types. A single fixed pulley is fastened by means of a hook to a support. Fixed pulleys are used for drawing water from wells. In a fixed pulley, the force applied is equal to the load lifted.

A movable pulley is provided with a hook for the load to be fastened. It is used to lift the load directly upwards. The pulley is made to roll on a rope fastened to a support on one end, and the other end is pulled upwards. The load is lifted twice as easily using a movable pulley as the effort used is only half as much as the load.

There are combinations of fixed and movable pulleys used to make work easier still.

The law of the levers can be applied to the working of the wheel and axle or the pulley also. According to the law of the lever, effort × effort arm = load × load arm. So in a pulley, if the load is lifted by one metre, the effort used has to travel four times as much—the rope has to be pulled through a distance of four metres. So also by using an effort equal to one kg weight, a load equal to 4 kg weight can be lifted.

Uses of pulleys

Pulleys are used in flag posts, in wells, to fasten clothes lines, in building sites and in cranes.

Things to remember

1. A simple machine is a device used to make work easier.
2. There are six basic machines. They are the lever, the inclined plane, the wedge, the screw, the wheel and axle and the pulley. Modern machines are combinations of two or more of these machines.
3. The caveman used a lever to roll huge boulders without knowing that he was using a simple machine. A lever is a simple machine upon which an effort is applied to gain force, speed or distance.
4. In a lever, the place where the lever rests is called the fulcrum, the side where the force is applied is called the effort and the other side is called the load or the resistance.
5. There are three classes of levers.

The first class levers have their fulcrum between the load and the effort.

The second class levers have their load between the fulcrum and the effort.

The third class levers have their effort between the fulcrum and the load.

6. The law of the lever was discovered by Archimedes, the Greek scientist. According to the law of the lever, effort × effort arm = load × load arm.
7. An inclined plane is a simple machine which consists of a leaning surface along which objects can be pushed or pulled.
8. By keeping the height of the plane as low as possible we can gain more advantage in using an inclined plane.
9. A wedge is nothing but two inclined planes put together, back to back. It is a simple machine that is thick at one end and sloping to a thin edge at the other.
10. A wedge is used to cut, split or pierce through objects.
11. The screw is a modified inclined plane. It is an inclined plane wrapped around a cylinder.
12. A screw fastens up two blocks of wood better than a nail does.
13. The wheel and axle is a simple machine consisting of a wheel or a crank attached to an axle.
14. The pulley is a grooved wheel over which a rope passes.
15. We can apply the law of the lever to the working of the wheel and axle and the pulley.

Things to do

1. Balance your plastic or wooden ruler on your pointer (finger) by placing it at its centre point. To check the law of the lever, you can use two erasers, a smaller one placed at one end of the ruler and the bigger one placed a little closer to the fulcrum (the point at which the finger balances the ruler) to bring about a perfect balance!
2. Take a metre scale with a hole in the 50 cm mark. Hang it from a clamp. Use a 500 gm weight to support a 100 gm weight as you did with the erasers. Let the 100 gm weight be the effort and the 500 gm weight the load. Now measure the effort arm and the load arm. You will find that the effort arm will be five times

as long as the load arm. This proves the law of the lever. (Effort × effort arm = load × load arm.) (100 gm weight × 20 cm = 500 gm weight × 4 cm.)

3. Try to bring your bicycle onto the verandah of your house by lifting it. Do the same thing by rolling its wheels on a wooden plank kept inclined on the verandah steps. Which is easier?
4. Visit a harbour or a factory to see how huge cranes with pulleys are used for lifting heavy loads. Find out how a. a ship is loaded or unloaded; b. a derailed bogie or engine is lifted off a railway track.
5. Drive a blunt nail and a sharp nail into a wall or wooden board. Which is easier?
6. You can make a simple wheel and axle. Get an empty cotton reel—of wood or metal—and fix a long, cylindrical pencil firmly into its hole. Take a twine or a thin firm rope and wind it in one direction on the wheel and in another direction on the axle. Hang the apparatus from a window-sill using two loops. Tie two heavy loads one on either end of the twine. When you roll the pencil (axle), if the twine round it unwinds itself, bringing the load downwards, the twine round the cotton reel (wheel) winds itself lifting the other load up!
7. Watch how scouts use pegs (as wedges) and pulleys for tent-pitching.
8. Go to an automobile workshop and watch how a screw jack is used to lift cars and trucks.
9. Look for machines at home which you can handle. Experiment with them to find out how they work.

Exercises

1. Answer briefly:
   a. What is a simple machine?
   b. Name the six types of simple machines.
   c. What is a lever?
   d. What is a pulley?
   e. What is a wedge? What relationship does it have with an inclined plane?
   f. What is a wheel and axle?

2. Answer in detail:
   a. What are the three types of levers? Show the position of the fulcrum, the effort and the load in each type through diagrams.
   b. How does a windlass function? What is it used for?
   c. How can you show that the screw is only a modified inclined plane? Describe with suitable diagrams.
   d. How does the bicycle rear wheel function?
   e. Who discovered the law of the lever? Explain how the law works.
   f. A pulley also obeys the law of the lever. How?

3. Complete the following:
   - a. A simple machine is a device used ....
   - b. A lever is a simple machine upon which ....
   - c. In the first class lever, the fulcrum is between ....
   - d. In the second class lever, the load ....
   - e. In the third class lever, the effort ....
   - f. A pulley is a grooved wheel ....
   - g. A wedge is thick at one end and ....
   - h. A wheel and axle consists of a ....
   - i. An inclined plane is a leaning surface along which ....
   - j. A giant stairway is a ....
4. Match the following:

a. egg beater	inclined plane
b. scissors	pulley
c. mountain road	wheel and axle
d. knife	double lever
e. crane	wedge

5. Pick the odd one out giving reasons for your choice:
   - a. wedge, screw, inclined plane, lever
   - b. nut and bolt, bottle lid, screw, nail
   - c. claw-hammer, windlass, steering wheel, door knob
   - d. A pianist's stool, a winding stairway, a slope, a screw jack
   - e. a needle, a carpenter's plane, an axe, a pulley
6. Draw the following and mark their fulcrum, effort and load:
   - a. a pair of scissors
   - b. a see-saw
   - c. a nutcracker
   - d. a pair of tongs
   - e. a wheelbarrow

UNIT VIII *MATTER AND MATERIALS*

10. Comparing mass and volume of different substances

Properties of matter

1. How does matter exist? Matter exists in three forms — solids, liquids and gases.
2. Elements: Millions of complex substances found in the world are made up of about a little more than a hundred simple substances. These simple substances are called elements.
3. Atoms: The smallest part of an element is called an atom. An atom of an element is so small that it cannot be seen even through a powerful microscope. A pinch of sulphur or a tiny bit of carbon contains so many atoms that the number might exceed even the human population in your area! Atoms of different elements combine in different ways to form the millions of substances that we come across.
4. How do we name elements?' Scientists have devised a method of writing the names of elements in a short form. A hydrogen atom is represented by the alphabet 'H'. Similarly 'C' stands for carbon, 'O' for oxygen, 'N' for nitrogen and so on. These are called 'symbols' of elements.
5. Molecules: A molecule is again a very tiny particle of a substance. A molecule of an element consists of two or more atoms of the same kind. For instance, a molecule of hydrogen or oxygen or nitrogen consists of two atoms of the same kind. Therefore a molecule of hydrogen is written as H_2, a molecule of oxygen as O_2, a molecule of nitrogen as N_2 and so on. These are gases which contain two atoms in each of their molecules. A molecule of another gas called ozone has three atoms of oxygen in it. So it is written as O_3. Therefore most molecules are groups of tinier

substances called atoms.

6. Compounds: Not all forms of matter found in the world are simple substances called elements. Elements combine in different ways to give rise to millions of varied substances. Such substances are called compounds. A compound is made up of two or more elements. Therefore a molecule of a compound will contain two or more atoms of different elements. For instance, water is the most common substance known to you. It is a compound made up of two different elements, hydrogen and oxygen. Both these elements are gases, whereas water, which consists of these two gases, is a liquid! A molecule of water consists of two atoms of hydrogen and one atom of oxygen. So it is written as H_2O. A molecule of carbon dioxide consists of an atom of carbon and two atoms of oxygen. Therefore it is written as CO_2. Similarly a molecule of a gas called ammonia has an atom of nitrogen and three atoms of hydrogen. Therefore it is written as NH_3.

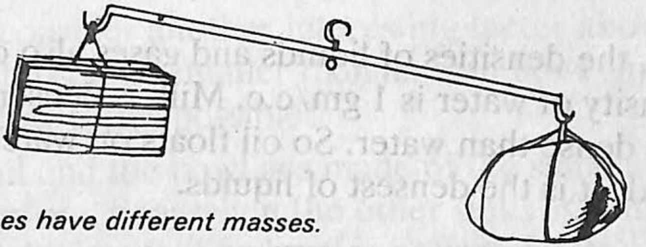
7. Inter-molecular spaces: Molecules of a substance do not lie touching each other but are separated from each other by a space called inter-molecular space. The molecules are held together by a force of attraction.

When you add sugar to a cup of milk, the volume increases a little. As you stir it with a spoon, you find that its original volume is restored. This is because sugar being soluble in water, allows its molecules to occupy spaces in between molecules of milk! The same thing happens when you add sugar or salt to water.

Any matter found on earth possesses weight as it is attracted by the force of gravity. Even a feather or a boll of cotton is made of matter. So it must have weight.

Have you ever been asked which is heavier, a kilogram of iron or a kilogram of cotton? You may be inclined, on first impulse, to say that the iron is heavier. But this is not so as they both weigh one kilogram each.

Let us compare the size or volume of these substances. An iron ball weighing one kilogram is very small. A ball of cotton of the same weight is very big. Why is this so? The matter of which the iron ball is made is different from cotton. Each particle of iron weighs more than one of cotton. Moreover, the particles of iron are very closely packed to make the iron ball small, but heavy. On the other hand, apart from each cotton particle being light, they are so loosely packed that the volume is enormous!



Different substances have different masses.

Let us now compare the 'mass' or quantity of matter in two different objects, such as a wooden block and a piece of stone, both appearing to have the same size or volume. The stone will feel heavier. It has more weight than the wooden block. Check this by placing them in a pair of scales. So it is clear that the total amount of matter in the stone is greater than that in the wood. Now we understand that different substances have different masses even if they are of the same size or volume.

What is density?

The lightness or heaviness of a substance for a given volume is called density. Density of a substance depends on how closely the molecules in the material are packed. Recall what is meant by the molecules of a substance.

When we say that the stone is heavier than the wooden block of the same size, we mean that the density of stone is more than that of wood. In other words, the molecules in stone are very closely packed, whereas in wood, they are fairly loosely packed.

Density is the mass of a certain volume of a substance or, density is mass per unit volume of a substance.

The unit of volume is 1 cubic centimetre or 1 c.c. where the cube has 1 centimetre length, 1 centimetre breadth and 1 centimetre height. Similarly the unit of mass is 1 gm. Therefore we always refer to the density of a substance as so many grams per c.c. (gm /c.c.).

When we say that the density of water is 1 gm/c.c., we mean that 1 c.c. of water weighs one gram.

So water is taken to be the standard for measurements of density.

Now we can say that iron is denser than cotton or stone is denser than wood.

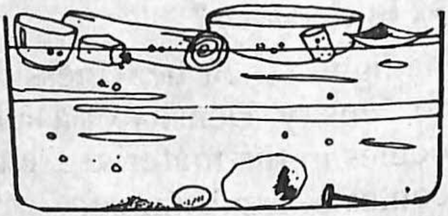
Just as in solids, the densities of liquids and gases also differ. You know that the density of water is 1 gm/c.c. Milk is denser than water, whereas oil is less dense than water. So oil floats on water. Mercury is a very dense liquid. It is the densest of liquids.

You can compare the volumes of different substances having the same mass or weight using a pair of scales. You will find that 1 kg of iron is small in size but sugar weighing 1 kg has much more volume! Weigh 1 kg of oil and 1 kg of water. Which of them will have more volume? Oil or water? 1 kg of oil certainly has greater volume than 1 kg of water as oil is less dense than water.

Floatation

You have learnt about suspended impurities in water. All suspended impurities are lighter or less dense than water. So they float on it or remain suspended.

Let us find out which materials are denser than water and which of them are less dense than water.



Which of them float and which of them sink?

Take a big glass basin or trough of water. Put several things such as a piece of wood, a cork, a pebble, a granite stone, a pinch of sand, a piece of paper, a nail, a plastic cup, an iron bowl and an ice cube into it. See what happens. Which of them float and which of them sink?

The piece of wood, the cork, the piece of paper, the plastic cup, the iron bowl and the ice cube float. The pebble, the granite stone, the sand and the nail sink.

The ice cube floats. This shows you how icebergs, though they are very huge, can float in the Arctic or Antarctic Ocean as their density is less than that of water. (An ice cube weighs less than the same volume of water) When an iceberg floats, nine-tenths of its total volume is below water and only one-tenth of its volume is above water. This is why icebergs are dangerous to ships.

Now let us consider another interesting factor about floatation. An iron nail which is much smaller than an iron bowl sinks, whereas the bowl floats! How is this possible?

Both the nail and the bowl are made of the same kind of matter. iron. Why does one float when the other sinks? Compare the volumes of the bowl and the nail. The bowl is hollow. So its volume increases. So the quantity of water it displaces is more. The weight of the water it has displaced is equal to the weight of the bowl. So the bowl is able to float on water. The nail is small. The iron molecules are very closely packed in it. It is not hollow. Its volume is less. It cannot displace water equal to its own weight. It sinks. Steel ships float in water as they are hollow like the bowl. They have an overall density of less than 1 gm/c.c. which means that they are shaped in such a way that their density will be less than that of water! Or, in other words, the volume of a ship is so enormous that much of its body is below the level of water, displacing enormous quantities of water, whose weight is equal to that of the ship. So ships with their body weight, the weight of the crew and the weight of the cargo can float because they are shaped that way whereas a tiny iron nail or an iron ball sinks!

Human beings are able to float or swim in water.

Animals or human beings are able to float or swim in water because they are about the same density as water. (Our body substances are made that way.)

An aeroplane is made of a very light material. It is made mainly of aluminium. It is mixed with some other metals to give it the necessary strength to steer through air, but its density is kept very low.

What is a model aeroplane made of? Is it aluminium or wood? It is normally made of tough wood like balsa wood which has a very low density, like aluminium.

You know that sea water has a lot of salts dissolved in it. So its density is more than that of river water or fresh water. When a ship sails in a river it sinks lower than in the sea. So it has to be suitably unloaded for it to enter safely into a river port from the sea. On the other hand, when the ship has to sail in the sea, leaving a river port, it can take on more load in another sea port as sea water is denser than fresh river water. The ship with the same load sinks less in salt water than in fresh water.

All ships have a marking on the hull showing how far they can be loaded in fresh water or in salt water. These markings are done on a vertical line. This is called the 'plim-sol line'.'

The densities of different liquids vary. So an object which floats in water can sink in kerosene which is less dense than water. Similarly, an object which can float in mercury' will sink in water. Mercury is the densest of all liquids. A 'hydrometer' is an instrument used to measure the densities of liquids. A lactometer is used to measure the density of milk.

Things to remember

1. There are about a little more than a hundred simple substances found in the world. They are called elements.
2. a. A molecule of an element consists of two or more atoms of the same kind.
   b. A molecule of a compound consists of atoms of two or more elements.
   c. A molecule of oxygen (an element) contains two atoms of it (O_2).
   d. A molecule of ozone contains three atoms of oxygen (O_3).
   e. A molecule of water (a compound) contains two atoms of hydrogen and an atom of oxygen (H_2).

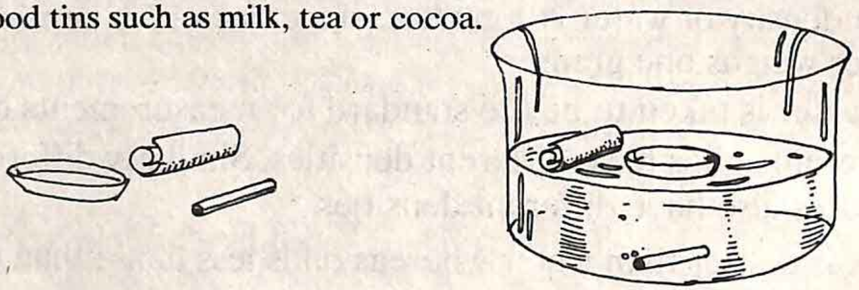
3. a. Molecules of a substance are held together by a sort of force or attraction.
   b. Molecules have inter-molecular spaces.
4. Matter has weight.
5. Equal volumes of different substances have different weights.
6. Density is mass per unit volume of a substance.
7. A denser object has its molecules more closely packed than a less dense object.
8. A stone is denser than a block of wood of the same volume.
9. The density of water is 1 gm/c.c, since one cubic centimetre of water weighs one gram.
10. So water is taken to be the standard for measurements of density.
11. Different solids have different densities. Similarly different liquids or gases also have different densities.
12. Milk is denser than water whereas oil is less dense than water. So oil floats on water.
13. Mercury is the densest of liquids.
14. An object which floats in mercury will sink in water.
15. Any object that floats in a liquid must be able to displace the volume of liquid which has the weight of the floating object.
16. A ball of iron sinks whereas an iron bowl floats in water.
    a. A bowl or a ship is shaped in such a way that its overall density is less than 1 gm/c.c., less than that of water. So it floats.
    b. The part of the ship's hull which is under water is able to displace a volume of water equal to the ship's weight. So the ship floats.
17. Salt water is denser than fresh water. So a ship must have less load when it sails in a river than when it sails in the sea.
18. The plim-sol line shows various markings which tell us how far the ship can be loaded.
19. A hydrometer is an instrument used to measure the densities of liquids.
20. A lactometer is used to measure the density of milk.

Things to do

1. You know that wood floats in water. Take three wooden blocks each made of different kinds of wood. Draw a vertical line on each of them with a felt pen. Now let all of them float in a bowl of water. Mark the level of water with the felt pen on each of them. Now remove them from the water and compare the markings to know how far each of them had to sink in water.

   This experiment shows that the densities of the wooden blocks differ from one another. Each type of wood is either soft or hard. Plywood is very light. Teak wood is very heavy. So the density of plywood is less than that of teak wood.

2. Take three tin sheets of the same size. You can take the tin sheets used for sealing food tins such as milk, tea or cocoa.

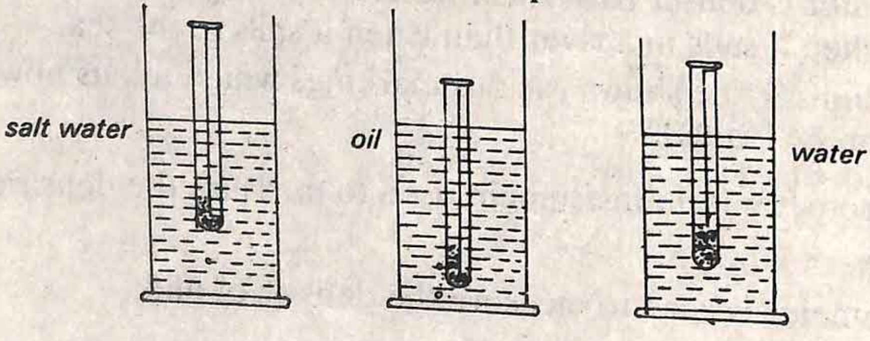


   Roll one tin sheet tightly. Roll the next one loosely. Fold the sides of the third one and make it into a bowl. Put all three in a basin of water. Which of them float and which of them sink?

   a. The tightly rolled sheet sinks as it can displace very little water.
   b. The loosely rolled tin sheet and the one shaped like a bowl float because they are both able to displace water equal to their own weight.

3. Take a test tube and let it float in a jar of water. It tilts. Add a little sand to it. It begins to float in a more upright manner. Add or remove sand to make it float in a vertical position. Now you have made a 'hydrometer'.

4. Paste a long slip of paper on a test-tube. Take three jars, one filled with water, the second one with oil and the third one with salt water. Use the same test tube float and add or remove sand to make it float vertically. Mark the level of liquid for each with different coloured felt pens.



Now compare the three markings. The test tube sinks more in oil then in fresh or salt water. It sinks more in fresh water than in salt water. So now we know that oil is less dense than fresh water. Salt water is denser, than fresh water.

You have made a hydrometer to measure the difference in densities in liquids.

5. How can you find out whether the eggs you have bought are fresh or spoilt? Put them in water and find out whether they sink or float. Which ones do you choose? The eggs that sink in water are the spoilt ones.
6. Take hollow sticks, like broomsticks made of spear grass. Break them into small pieces and make them float in water. Now push a common pin into some of them. You find these sticks sink in water. You can play a trick on your friends saying that only some sticks float and others sink!
7. Keep a few marbles in a beaker. Pour some sand into it and gently tap the vessel. Sand occupies the spaces in between the marbles. This is how molecules of a solute occupy the inter-molecular spaces of a solvent when they form a solution where the solute particles are evenly distributed.

Exercises

1. Answer briefly:
   a. What is density?
   b. How are we able to float or swim in water?
   c. What is a plim-sol line?
   d. What is a hydrometer?
   e. What is a lactometer?
2. Answer in detail:
   a. How can you find out which is denser and which is less dense when you are given two objects of the same volume and a pair of scales?
   b. How does a ship float whereas a ball of steel sinks in water?
   c. How can you make a test-tube float erect in a jar of water?
   d. How can you compare the densities of liquids using a test-tube float?
   e. Explain why a ship loaded to its maximum limit will sink if it has to enter a river from the sea.
3. Circle the objects which can float in water:
   a matchstick, a small metal rod, a large pencil, a tin foil rolled tightly,
   a marble, a stone, a tin foil rolled loosely, a cork, a pebble, a piece of glass,
   a metal cup, a glass test-tube.
4. Fill in the blanks using the words 'denser' or 'less dense'.
   a. Mercury is .... than water.

b. Oil is .... than water.
c. Wood is .... than stone.
d. Cork is .... than water.
e. Aluminium is .... than iron.
f. Teak wood is .... than plywood.
g. Salt water is .... than fresh water.
h. Water is .... than milk.

5. Fill in the blanks using the words 'float' or 'sink'.
   a. An object which .... in mercury will .... in water.
   b. A heavily loaded ship which might .... in river water can .... in sea water.
   c. A tin sheet shaped into a bowl .... in water whereas it .... when it is rolled tightly.
   d. A tiny broomstick .... in water whereas it .... when a pin is inserted into it.

6. Give reasons for the following:
   a. Adding sugar to water causes a slight increase in volume whereas when it is stirred, the original volume is restored.
   b. A molecule of ozone is written as O_3.

7. Match the following:

water	element (gas)
ammonia	smallest part of an element
oxygen	compound (liquid)
atom	NH_3
carbon dioxide	N_2
molecule of an element	CO_2
molecule of a compound	is made up of two or more atoms of the same kind
nitrogen	consists of two or more atoms of different elements

11. Organs and organ systems of man

Bones

Bones form the framework of the body. They are mainly made up of two important minerals called calcium and phosphorus. When you are very young, your bones are soft and can be easily bent. As you grow older your bones become hard and strong. There are 206 bones in the body. These are joined together to form the skeleton.

Bones making up the skeleton are of different sizes and shapes. Some bones, like those found in the arms and legs, are long. The bones of the ribs are long and curved. The bones in the ankle and wrist are small, while those of the backbone are small, irregular and have an opening in them. The spinal cord passes through this opening. There are flat plate-like bones like the shoulder blades. Other flat plate-like bones are curved, like that of the brain box or cranium.

Most short bones are solid. Many of the long bones are hollow which makes the skeleton considerably lighter. Certain hollow bones contain bone marrow within them. Marrow is a soft, fatty material.

Uses of bones

1. The skeleton supports and gives shape to the human body.
2. The skeleton protects the important internal organs.

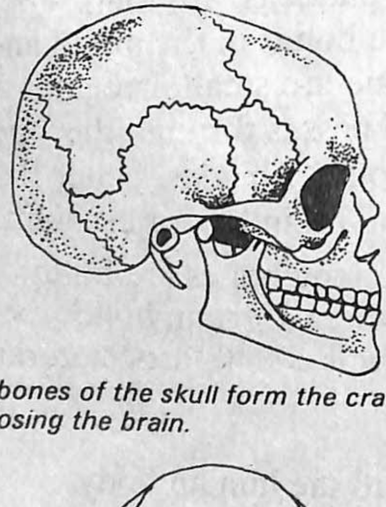
   Thus the heart and lungs are protected by the rib cage formed by the backbone (vertebrae), ribs and chest bone or sternum. Can you say what important organs the skull and backbone protect?
3. The bones provide a place for attachment of muscles and provide suitable leverage for movement. These muscles, together with the joints, enable the bones to move. Can you recall how the bones of our arms and legs act as levers?
4. Bones act as storehouses for important minerals needed by the body.

5. The bone-marrow found in the cavities of the long bones produces red blood and white blood cells.

Parts of the skeleton

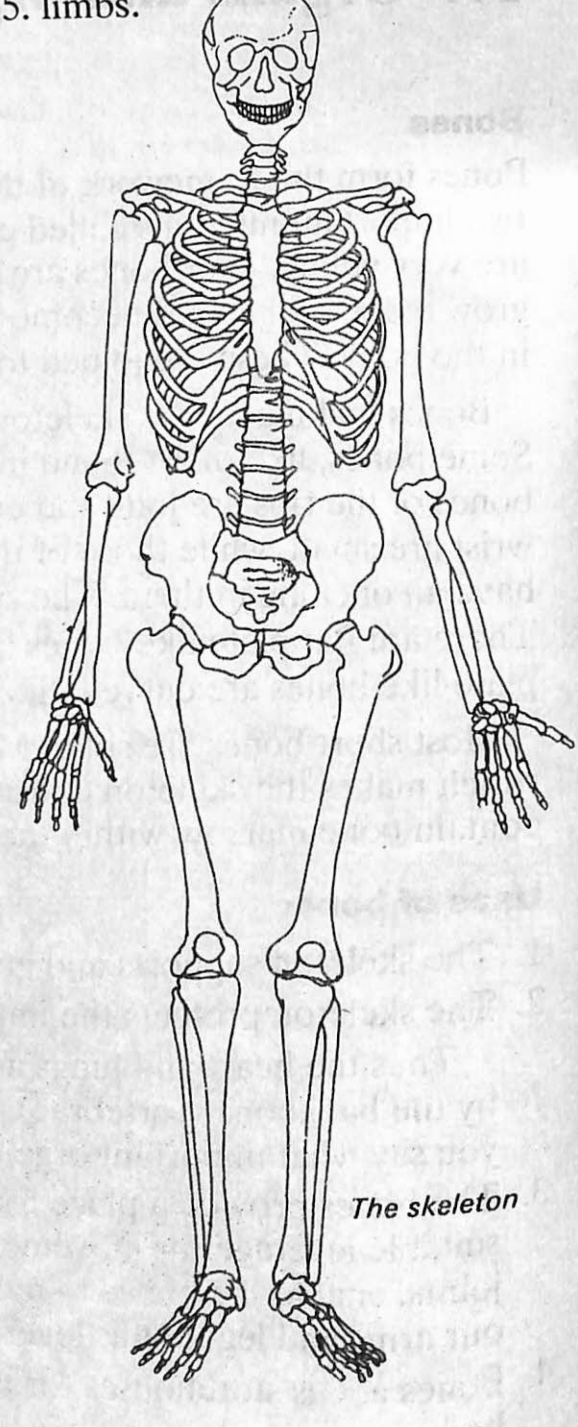
The skeleton is made up of 1. the skull; 2. the vertebrae; 3. the sternum and ribs; 4. girdles; 5. limbs.

The skull is made up of several pieces of flat bones fitted together, and enclosing a cavity in which the brain lies. The bony box which encloses the brain is the cranium. The face is made up of 14 bones joined together. Of these, the lower jaw alone is movable.

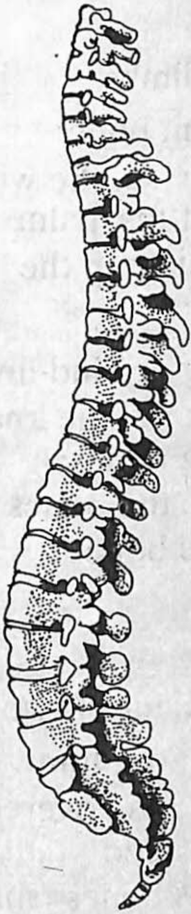


The bones of the skull form the cranium, enclosing the brain.

The face is made up of 14 bones joined together.

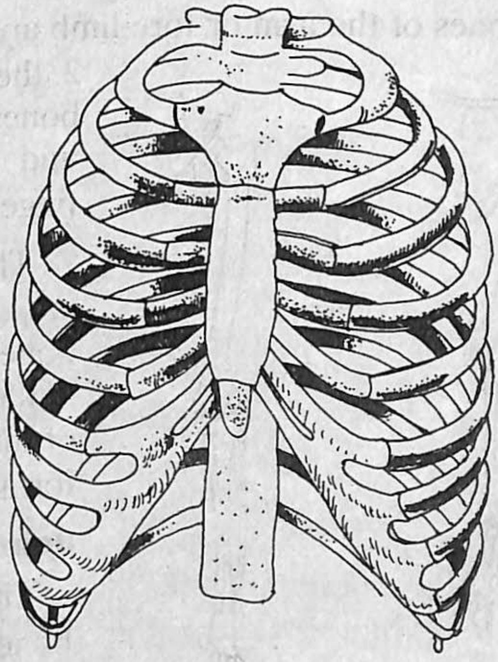


The skeleton



The vertebrae form the backbone or spine.

The bones of the chest form a cage for the heart and lungs.



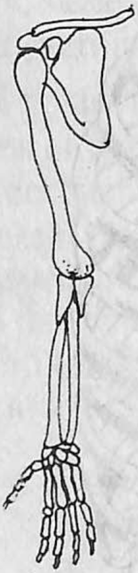
The backbone is made of 33 small bones called vertebrae. These lie like blocks strung together, and form the spine or backbone which is also called the vertebral column. Because each of these bones has an opening in it, a canal is formed running down the entire length of the backbone. The delicate spinal cord passes through this canal.

The bones of the chest form a box or a cage in which the heart and lungs lie. The chest box or the rib cage is made up of 12 pairs of flat, curved bones called ribs. The ribs are joined at the back to the backbone. In front, the first 10 pairs of ribs are attached to the breastbone or sternum. The last two pairs, which are not long enough to join the breastbone, are called floating ribs.

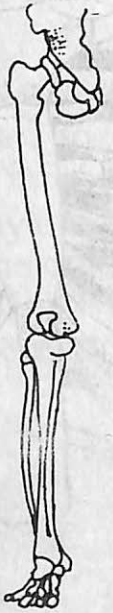
The bones of the limbs are attached to the girdles. The upper arm bone is attached to the shoulder girdle. The thigh-bone is attached to the hip girdle. The shoulder girdle is formed by the shoulder blades and the collar bones. The hip girdle is formed by fusion of three pairs of bones. These are attached to the backbone at the back.

Limbs consist of a pair of fore-limbs and a pair of hind-limbs.

The bones of the arm or fore-limb are 1. the upper arm bone; 2. the lower arm bones; 3. the wrist bones; 4. the bones of the palm and 5. the bones making up the fingers.



The bones of the arm



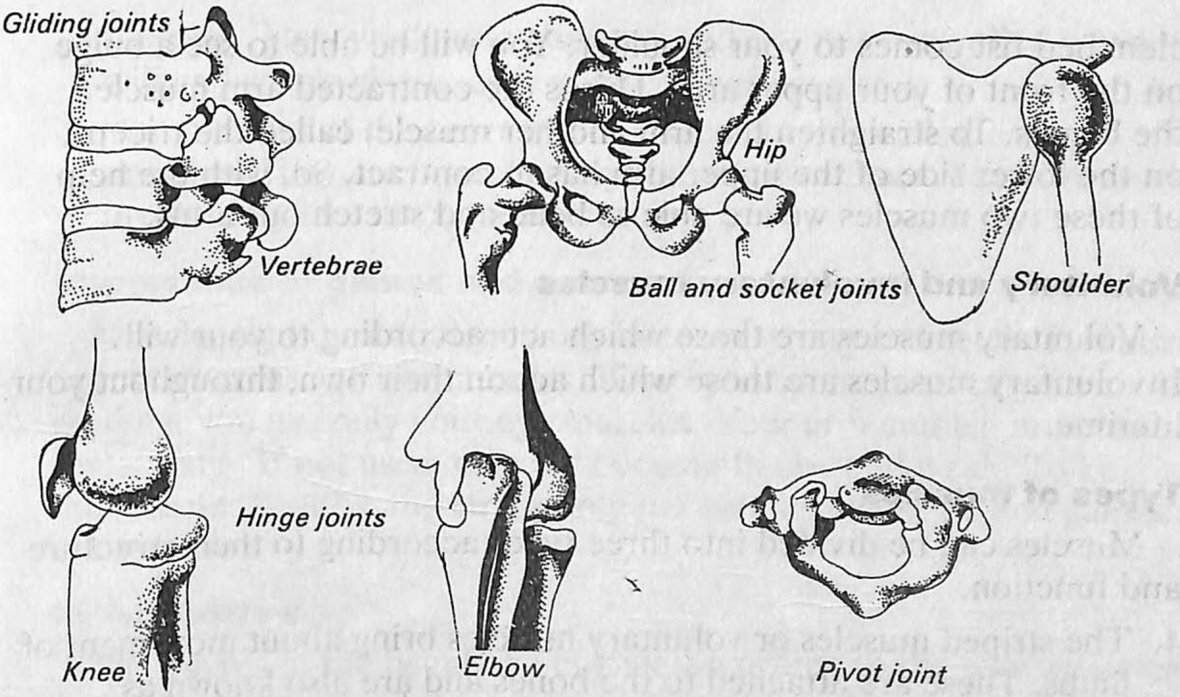
The bones of the leg

The bones of the leg or hind-limb are 1. the thigh bone; 2. the knee bone; 3. the lower leg bones; 4. the ankle bones; 5. the bones of the foot; and 6. the bones forming the toes.

Joints

The place of attachment of two bones is called a joint. At a joint, the surface of the bones is covered by an elastic material called cartilage. This prevents bones from rubbing against each other. Bones are held together by a stiff, tough material called ligament. Some bones are completely fused together and show no movement. Such joints are called immovable joints. Some other bones are so joined that they can move. These movable joints are of four types:

1. Ball and socket joint: This joint is found in the shoulder and the hip. Such a joint makes movement possible in all directions—bending, stretching and rotation.
2. Hinge joint: This type of joint is found in the elbow, knee and fingers. Here the movement is possible only in one direction. Move your fingers, knee or elbow and see in how many directions you can move them.
3. Angular joint or gliding joint: In this type of joint movement is possible in two directions. The joints at wrist and ankle and



between the vertebrae are of this type. Here the bones glide over one another and enable us to bend our back, twist and turn, handle tools, write, dance and play.

4. Pivot joint: This type of joint is found between the skull and the first two vertebrae. It is also found between the two lower arm bones. This is responsible for the up and down, and the turning movements of our head. Thus we nod our head or turn it from side to side.

Muscles

Muscles occupy a major portion of the body. Some of them are attached to the bones of the skeleton. There are more than 600 of these skeletal muscles. The skeletal muscles are attached to the bones by means of tough cords called tendons.

Contraction of muscles

Muscles work not by pushing but by pulling. They become shortened or contract when they work. When they contract they move the bone to which they are attached. You can see how the muscles of your arm contract. Bring your fore-arm up so that your clenched fist comes to your shoulder. You will be able to see a bulge on the front of your upper arm. This is the contracted arm muscle, the biceps. To straighten the arm another muscle, called the triceps, on the lower side of the upper arm has to contract. So, with the help of these two muscles we are able to bend and stretch our arms.

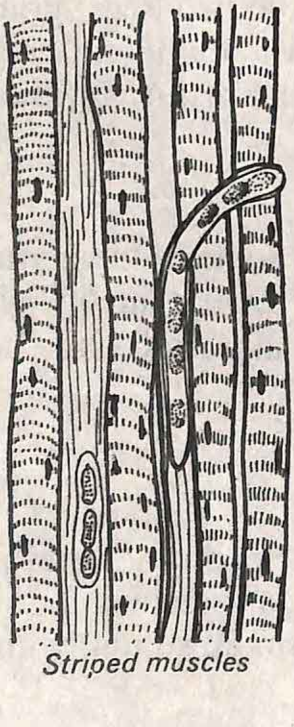
Voluntary and involuntary muscles

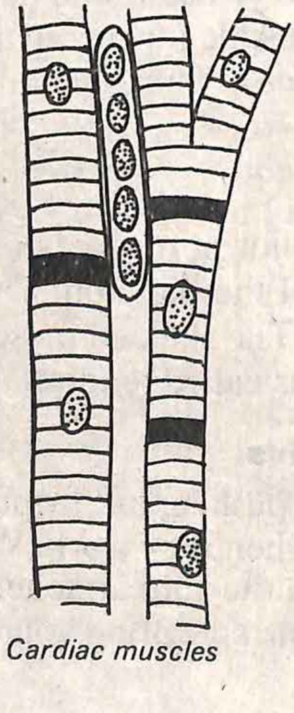
Voluntary muscles are those which act according to your will. Involuntary muscles are those which act on their own, throughout your lifetime.

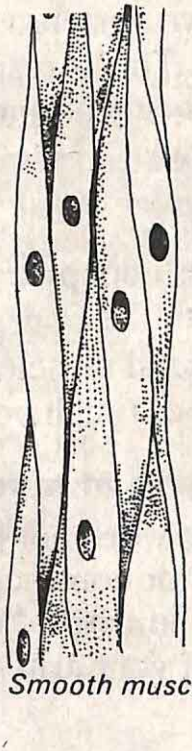
Types of muscles

Muscles can be divided into three types according to their structure and function.

1. The striped muscles or voluntary muscles bring about movement of limbs. These are attached to the bones and are also known as skeletal muscles. These muscles have bands or stripes on them. They are under the control of your will.
2. The smooth muscles are found lining the food canal and the blood vessels. They are not striped and so are called smooth or unstriped


Striped muscles


Cardiac muscles


Smooth muscles

muscles. They work automatically and are not controlled by your will and so are also known as involuntary muscles.

3. The muscles of the heart are of a special type, called cardiac muscles. They are branched and have faint stripes. But they are involuntary like the smooth muscles.

Importance of games and exercises

Muscles that do sufficient work become strong and thick. It is also necessary to use all our muscles. When you spend most of your time reading, you use only your eye muscles. Your arm and leg muscles remain idle. If not used, muscles become flabby and weak. To keep all the muscles healthy and strong, regular physical exercise and games are essential.

Right posture

The curves of the backbone change according to the way we sit and stand and move. If we stoop when we walk, stand or work, our backbones curve in an unhealthy and incorrect way. Similarly, it is essential that we sit erect. Improper posture leads to a mis-shapen body, awkward movements and disorders of the muscles and nerves.

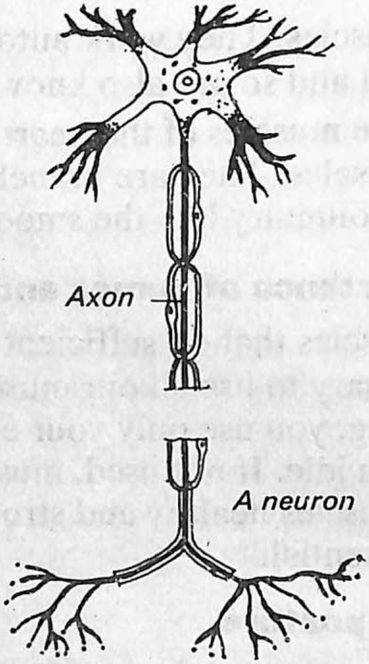
The nervous system

All the systems of the body perform various important functions. To bring about the smooth and coordinated functioning of all organs making up these systems, a controlling centre is essential. This regulation and coordination is brought about by means of the nervous system. The nervous system functions in two ways:

1. It controls all the organs within the body.
2. It responds to surroundings through the sense organs. This is why you move away from a car that you see approaching you. This is called 'response to stimulus'.

Nerves

The nervous system is made of special cells called neurons. Look at the structure of a neuron in the figure. The axon or the nerve fibre is very long. Bundles of nerve fibres form a nerve. The nerves connect the controlling centres (brain and spinal cord) with muscles, organs and the sense organs. The nerves carry messages (impulses) to and from the brain. Nerves are of three types according to the nature of the nerve fibre present within them.



A neuron

They are,

1. Sensory nerves: These nerves have only nerve fibres that carry impulses from the sense organ, like the eye, to the brain and spinal cord. Because of these we are able to see, hear, smell, taste and feel.
2. Motor nerves: These have nerve fibres that carry messages from the brain to the internal organs and muscles. Movement of muscles and secretion of glands are brought about through these nerves.
3. Mixed nerves: Such nerves possess both sensory and motor nerve fibres. These nerves carry impulses to and from the brain and spinal cord.

The nervous system is divided into three major groups:

1. The central nervous system;
2. The peripheral nervous system;
3. The autonomic nervous system.

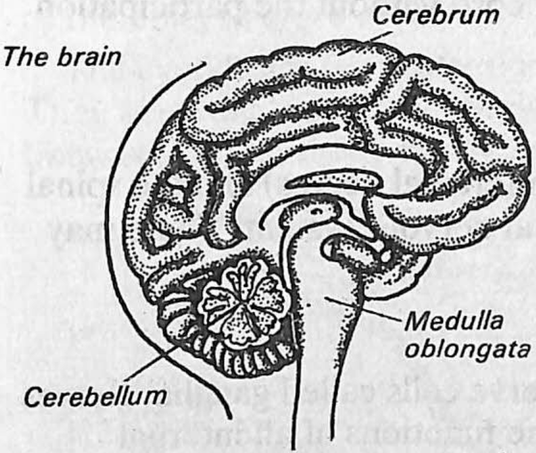
The central nervous system

The central nervous system includes the brain and the spinal cord.

The brain is protected by the skull. It is also cushioned from external shocks by a fluid which surrounds it and is present within it. The brain is made up of three main parts.

1. The cerebrum (the big brain): This is the largest part of the brain The surface of the cerebrum has deep folds. The cerebrum is filled with neurons and nerves. Different areas in the cerebrum have different functions. Thus there are specialised areas for speaking,

writing, memory, thinking and receiving impulses from sense organs.



2. The cerebellum: The cerebellum is tucked in under the back of the cerebrum. It is also called the little brain. The cerebellum coordinates the movement of the muscles of the body. If the cerebellum is injured you will make clumsy, vain attempts to pick up a ball or even find walking straight difficult.
3. The medulla oblongata or the brain stem is attached to the cerebellum. The neurons which are present here control important activities like the heartbeat and breathing. It also serves as a passage for nerve fibres passing between the brain and the spinal cord.

The spinal cord

The brain continues downward as the spinal cord. Each of the bones making up the backbone has an opening. Through this the spinal cord passes as a long continuous tube. The spinal cord, like the brain, is protected from shocks by fluids present around it. The spinal cord has numerous neurons and nerve fibres. It has two main functions.

1. It serves to connect the brain with all other organs in the body.
2. It is responsible for reflex actions.

Let us study an example of a reflex action. Unknowingly, you may step on a pin or a nail. How do you react? You immediately withdraw your leg, within a fraction of a second. Only after you have removed your foot do you feel pain. This is a reflex action. What has happened? When you stepped on the pin, nerve cells in the skin passed a message to the nerve cells in the spinal cord. These, on receiving the message, sent an 'order' through another nerve fibre to the leg muscles to contract and so withdraw. This was the reflex action. At the same time, or a little later, nerve fibres from the spinal cord 'informed' the brain. Only then did you feel pain. Such kinds of responses, brought about by the spinal cord without the participation of the brain, are called reflex actions.

The peripheral nervous system

The nerves that arise from the brain (cranial nerves) and the spinal cord (spinal nerves) form the peripheral nervous system. These may be sensory, motor or mixed nerves.

The autonomic nervous system

This system has special groups of nerve cells called ganglia. Nerves rise from these ganglia and regulate the functions of all internal organs like the heart, lungs and liver. They can either speed up or slow down the functions of the organs.

Sense organs

All of you must have visited a park. Let us think of some of the things that you enjoy there. You see colourful flowers. You hear the music of the birds. You smell the scent of the flowers and the fruit. You taste the sweetness of a fruit. You feel the smoothness of the petals or the roughness of the bark.

You should be grateful to five parts of your body for your enjoyable visit to the part. They are your eyes, ears, nose, tongue and skin. These parts make us aware of our surroundings. Since they perform the function of sensing the world around us, they are called sense organs. There are five sense organs in the body.

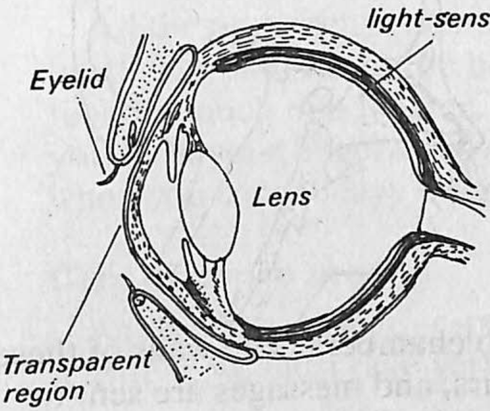
Eyes

The eye is one of the most important sense organs. With the eyes closed you will not be able to read, write or even move about with confidence. The eye is about the shape and size of a table-tennis ball. It has a transparent part, rather like a window, at the front.

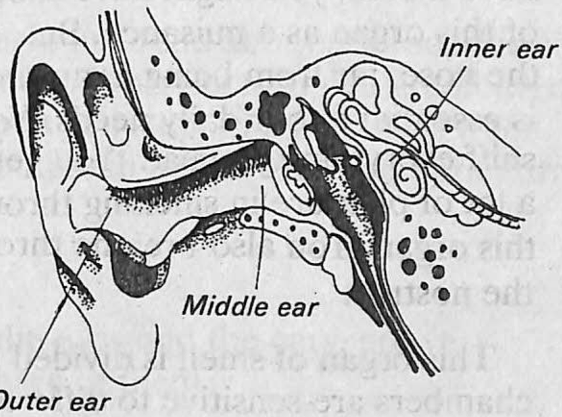
Just behind this transparent region is a lens. The inside wall of the eye is sensitive to light and colours. Light passes through the transparent membrane and the lens and then strikes on the wall. The sensitive wall sends an impulse through a sensory nerve to the brain which is able to read the message and know the shape, size and colour of the object before us.

The eyelids are for protection. They act as windscreen wipers. They keep the transparent region moist and clean. The eyelashes, likewise, stop dust and sweat from entering the eye.

Section of the eye



Section of the ear



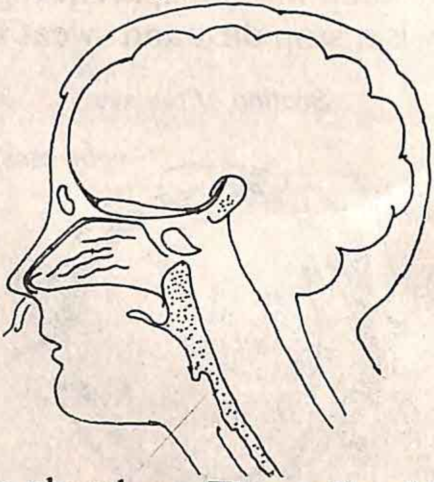
Ears

Another most important sense organ is the ear. Close your ears for a few minutes and you feel very lonely. The outer flap of skin you see is only a portion of the ear. It is just a sound-gathering trumpet. In some animals, as in snakes and frogs, these flaps are absent altogether. In other animals, as in elephants, rabbits and dogs, they are very big and movable.

The outer ear leads into a narrow corridor or canal. This canal has wax which prevents dust and small insects from entering into the ear. At the end of the canal is a thin, sensitive membrane called the ear drum. Three very tiny bones forming a chain are attached to the ear drum in front and to the inner ear at the back. The inner ear is a chamber filled with a fluid. In the middle of this fluid is a coiled structure shaped like a snail's shell. A nerve connects this structure with the brain.

When a bell rings, sound vibrations are collected by the outer ear and travel through the canal and strike the ear drum. The three bones receive these vibrations which then reach the coil of the inner ear. The coil, which is sensitive to these sound vibrations, sends an impulse to the brain through the nerve. The brain enables you to recognise the type of sound and you hear the bell ringing.

Nose

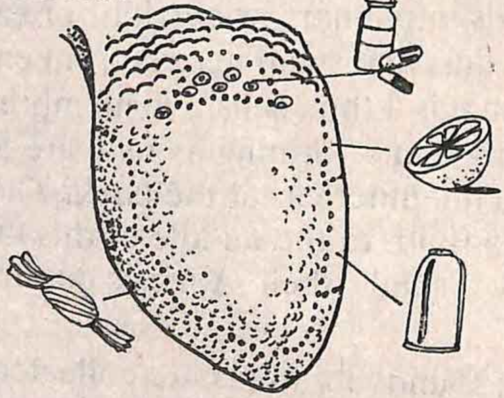


Organ of smell

Sometimes, particularly when you have a cold, you might have thought of this organ as a nuisance. But the nose, far from being a nuisance, is essential to our daily needs. You sniff everything you eat. You get a lot of pleasure in smelling through this organ. You also breathe through the nostrils.

This organ of smell is divided into two chambers. The walls of these chambers are sensitive to different odours, and messages are sent to the brain. You then know whether a smell is pleasant or unpleasant. You can in this way recognise hundreds of different smells. Tiny hairs, which filter dust particles from the air coming in, are present in the nostrils. The nose produces a sticky liquid which acts as a flypaper to catch bacteria and dust particles.

Some animals' noses are much more sensitive than those of humans. Can you name one such animal?



Taste buds

Tongue

The tongue is about ten cm long. Examine your tongue in the mirror. If you look carefully you will see that the surface has many tiny knobs. These are called taste buds. The surface of the tongue is sensitive to salt, sweet, bitter and sour tastes. Have you noticed that your sense of taste does not work well when you have a severe cold? This is because the taste buds cannot do their work without the help of the sense of smell.

Skin

All the other sense organs you have just read about are found in the head. The skin forms the body surface. With the skin you are able to feel the touch of a feather, pain when you step on a nail, heat when you burn your finger, cold when you touch an ice block and pressure when you carry heavy weights.

Care of sense organs

As our sense organs, especially the eyes and the ears, are very sensitive, we must take very good care of them.

Care of the eyes

1. Natural or artificial light striking the eyes should not be too bright or too dim. Very bright or very dim light spoils our eyesight. Our eyes begin to water due to strain.
2. Good posture is necessary for reading or writing. We should not read while lying down.
3. The source of light should be behind the left shoulder when we read or write, so that our shadow will not fall on the book.
4. Eyes should be washed with clean water or with eye lotions. Dust particles or germs in the eyes can cause eye diseases which may even lead to blindness.
5. Sharp instruments should be handled carefully and our eyes should be protected from them.

Care of the ears

1. Our ears are as delicate as our eyes. We should not use sharp instruments to clean the ears of wax. When excessive wax blocks up the ears, have them cleaned by a doctor. Tiny insects and other

foreign particles which get into our ears should also be removed by a doctor. For regular cleaning of the ears do not use sharp instruments which can puncture the ear drum and make you deaf. A little coconut oil may be used to loosen the wax which can then be removed using the corner of a clean cloth.

2. We should not be hit over our ears. The ear drum may tear and the delicate internal ear may get damaged.
3. Our ears should not be exposed to excessive noise. Do not shout into anyone's ears, even for fun. Children should not be taken to factories where machines make a loud and continuous noise. Noise not only causes headaches but also damages the delicate internal organs of the ear.

Care of the nose

1. There is a connection between the nose, the throat and the ear. So when the nose and the throat are blocked with phlegm, the ears ache. Phlegm in the nose should be cleared very carefully. Eucalyptus oil vapour can be inhaled to dissolve the phlegm. It should then be blown out from each nostril separately with the other nostril closed with a finger. If this is not done, the ear drum can get damaged due to excessive pressure caused by blowing the nose.
2. Care should be taken that children do not put seeds, small objects or tiny stones into their nostrils.

Care of the skin

1. The skin should be regularly washed free of dirt and sweat with soap and water. Otherwise the sweat pores will be blocked and germs will collect in the dirt. This will cause prickly heat, boils and other skin diseases.
2. Clothes must be washed clean, especially the undergarments.
3. Clothes made of artificial fibres should not be worn next to the skin.
4. We should not wear others' clothes as we may get skin diseases like ringworm or eczema from them.
5. We should wear clothes suitable to the climate.

What are microbes?

Microbes are tiny organisms which can be seen only under a microscope.

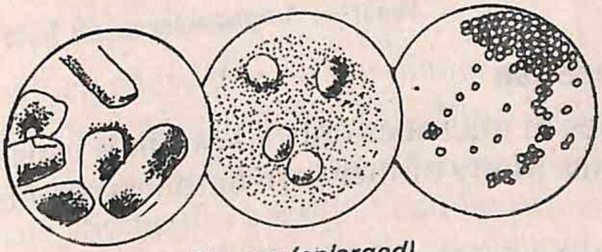
They are found everywhere—in the air, water, soil and food. Some of them live as parasites within or outside the body of animals. One such parasite of man is the microbe causing malaria.

Microbes can do whatever your body cells can do—they produce enzymes, digest food, release energy and reproduce.

They reproduce and multiply in large numbers within a very short time if there is enough food, moisture and suitable temperature. (Recall the conditions necessary for the germination of seeds.) Microbes may be useful or harmful to man. Diseases caused by microbes are infectious.

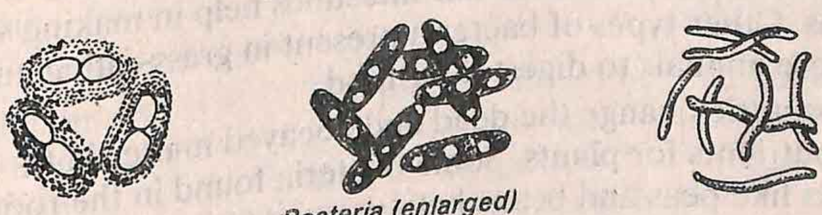
Types of microbes

1. Viruses: Viruses are very small and can be seen only with special types of microscopes. They are responsible for many infectious diseases like influenza, measles and chicken pox.

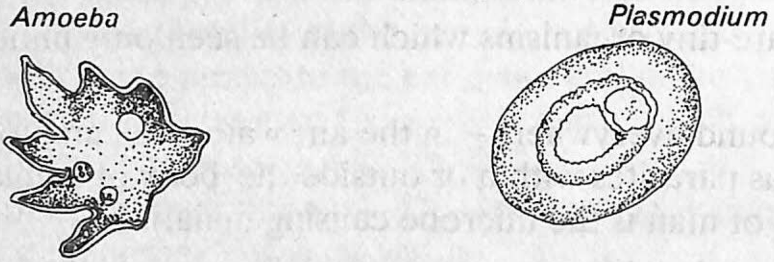


Viruses (enlarged)

2. Bacteria: These are slightly larger than viruses. They are small, single-celled plants. But they do not have chlorophyll. They may be rod-shaped, spiral or rounded. Some of them cause diseases like tuberculosis, cholera and typhoid.

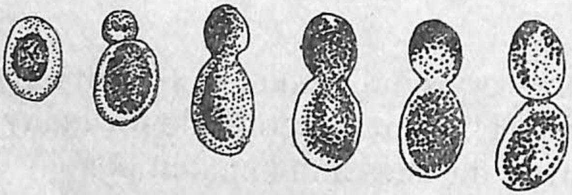


Bacteria (enlarged)



Protozoa (enlarged)

3. Protozoa: These are also single-celled animals. Only a few protozoa, like amoeba and plasmodium, are harmful.
4. Fungi: These are also plants without any chlorophyll. They are larger than bacteria. Fungi are usually parasites of plants and animals.



Yeast—a fungus

Some useful microbes

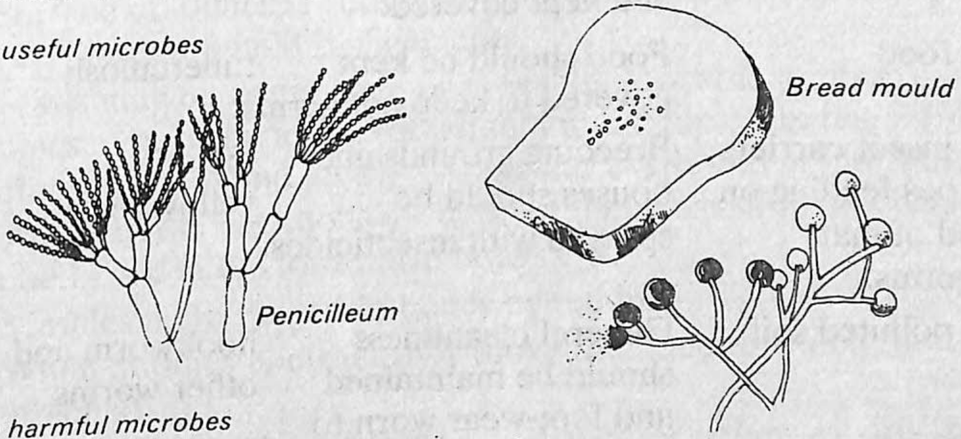
Of the many types of microbes only a few kinds cause diseases in us and in other animals. Many of them are harmless. Quite a few are useful to man.

1. Bacteria are helpful for breaking down sewage and dead parts of plants and animals in the soil. This makes our surroundings healthier to live in.
2. Milk changes to curd or cheese through the action of bacteria or moulds. Some types of bacteria change alcohol to vinegar.
3. Bacteria that are present in our intestines help in making some vitamins. Other types of bacteria present in grass-eating animals help these animals to digest their food.
4. Some bacteria change the dead and decayed matter in the soil into useful nutrients for plants. Some bacteria found in the root nodules of plants like peas and beans help these plants to prepare nutrients

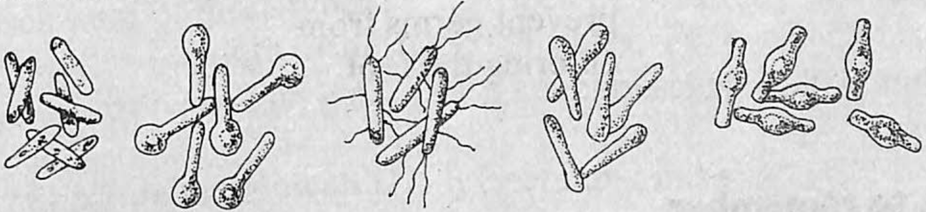
using nitrogen from the atmosphere (fixation of nitrogen).

5. Yeast, which is a fungus, is used in baking bread.

Some useful microbes



Some harmful microbes



Some harmful microbes

Microbes which cause diseases in plants and animals are commonly called germs. These germs spread in various ways.

Vaccination and inoculation against most diseases prevents the spread of germs. Some diseases that can be prevented by these methods are small-pox, rabies, tetanus, polio and typhoid.

Here is a table to show the ways in which germs spread. It also shows you how the spread of disease-producing germs can be stopped.

How the disease is spread	How to stop spread of the disease	Examples of disease-spreading organisms
through contact with the person and through air	The patient should be isolated. Materials used by the person should be disinfected.	smallpox diphtheria influenza

through water and milk	Drinking water and milk should be boiled and kept covered.	typhoid, cholera, dysentery
through food	Food should be kept covered to keep out germs.	tuberculosis
through insect carriers Mosquitoes feeding on the blood of man spread germs.	Breeding grounds and houses should be sprayed with insecticides.	malaria, yellow fever
through polluted soil	General cleanliness should be maintained and foot-wear worn to prevent germs from entering the foot.	hookworm and other worms

Things to remember

1. There are 206 bones in the body. Together they form the skeleton.
2. Bones are of different shapes and sizes.
3. Uses of bones are:
   a. support; b. protection; c. site of attachment for muscles; d. storehouses of minerals; e. production of red and white blood corpuscles.
4. The skeleton consists of:
   a. The skull made up of many bones, including the fourteen bones of the face. It protects the brain.
   b. The backbone, or the vertebral column, is made up of 33 small bones called vertebrae. The spinal cord passes through the canal formed by these bones.
   c. The ribs are twelve pairs of flat, curved bones. The first ten pairs are attached to the breastbone or sternum in front. The last two pairs are the floating ribs. The ribs are attached at the back to the chest vertebrae of the backbone.
   d. Girdles are a pair of shoulder girdles and a pair of hip girdles.

   e. Limbs are attached to the girdles. Each limb is made up of many bones.

5. Surface of bones is covered by cartilage at a joint. At a joint, the two bones are held by ligaments.
6. Joints may be immovable or movable. Movable joints are of four types: a. ball and socket (shoulder and hip); b. hinge (fingers, elbows, knees and jaws); c. angular (wrist and ankle, hand and foot, and the backbone); d. pivot (between skull and backbone, and between the lower arm bones).
7. Muscles are attached to bones by tendons.
8. When muscles contract they move the bone to which they are attached.
9. Muscles are of three types: a. striped or voluntary or skeletal muscles; b. smooth or unstriped muscles; c. cardiac muscles.
10. Physical exercises and games help keep muscles healthy and strong.
11. Right posture prevents the body becoming mis-shapen.
12. The function of the nervous system is to regulate and control the functions of the various organs in the body. It also helps us to sense and respond to our environment.
13. The nerve cell or neuron has a long axon or nerve fibre. Bundles of nerve fibres form a nerve. The nerves connect the brain and the spinal cord with the organs of our body. They are of three types: a. sensory; b. motor and c. mixed.
14. The nervous system can be divided into:
    a. the central nervous system made up of the brain and the spinal cord. The brain has three parts—the cerebrum, the cerebellum and the medulla oblongata. The spinal cord is responsible for reflex actions;
    b. the peripheral nervous system; and
    c. the autonomic nervous system.
15. Eyes, ears, nose, tongue and skin are the sense organs. These have special sensitive cells which are connected to the brain by means of nerves. With the help of these we are able to see (eyes), hear (ears), smell (nose), taste (tongue) and feel (skin) different

sensations. We should keep our sense organs clean and protect them from injury.

16. Microbes are microscopic organisms found everywhere. They can be harmful or useful.
17. Microbes may be viruses, bacteria, protozoa or fungi.
18. Some useful microbes help in breaking down wastes, changing milk to curd, in digestion, in making bread and in obtaining nutrients for plants.
19. Some harmful microbes cause communicable diseases like small pox, diphtheria, malaria, tuberculosis. Vaccination and inoculation help prevent the spread of these germs.

Thing to do

1. Use parts of your mechano set to make a model of the human arm and show how it works as a lever. If you do not possess a mechano set you can make use of cardboard and pins to make the same model.
2. When dust particles fall into your eyes, close the eyelids and find out how your tear glands work. Note how tears collect and roll down, washing the dust particles out.
3. Regular exercises help you to build up your body muscles. Be alert in your drill classes and do the exercises properly.
4. Give proper exercise to your eye muscles. Open and close your eyelids at regular intervals, looking at green plants or sunlight (not the direct rays of the sun).
5. The best way to understand the skeletal system is to look at a human skeleton and observe the shapes and arrangement of bones.
6. Do you know how helpful your tongue is in swallowing food? Try to swallow chewed food, holding your tongue with your hand. Now you can understand how it is impossible to swallow without the movement of the tongue.
7. Do breathing exercises. Inhale and exhale, touching your ribs and vertebrae with your hands. Now you can understand how the diaphragm attached to your ribs helps in moving the ribs to bring about expansion and contraction of the chest cavity when you breathe.
8. Observe a young child who is trying to walk. See how difficult it is for the child to take a step forward. Walking is done with great effort by a child whereas you do it easily without conscious effort. Thus all responses are learned and stored as memory. We perform our work easily when we get used to it.

Exercises

1. Answer briefly:
   - a. Name the minerals found in the bones.
   - b. What is the marrow found in bones? What is its use?
   - c. How many bones make up the face? Which of these bones is movable?
   - d. What are floating ribs?
   - e. What type of joint connects the head and the neck?
   - f. What is a tendon?
   - g. Name the muscle that straightens your arm.
   - h. Give another name for skeletal muscles.
   - i. What are the cells making up the nervous system called?
   - j. Mention two important activities under the control of the medulla oblongata.
   - k. What is the purpose of the fluid surrounding the brain and the spinal cord?
   - l. Define reflex action.
   - m. What types of nerves make up the peripheral nervous system?
   - n. Mention two types of sensations you feel with the help of the skin.
   - o. What is the function of the wax found in our ears?
   - p. Name a disease caused by a virus.
   - q. Name a fungus that is useful to us.
   - r. Can you say what insect spreads malaria?
   - s. Why should water be boiled before drinking?
   - t. Name one disease that can be prevented by vaccination.

2. Answer in detail:
   - a. What are the uses of bones?
   - b. List the bones making up the limbs.
   - c. Describe hinge and ball and socket joints.
   - d. What are skeletal and smooth muscles? Where are they found and what is their function?
   - e. What are sensory and motor nerves?
   - f. What is the cerebrum? What is its function?
   - g. With an example, explain reflex action.
   - h. How do we 'see' an object before us?
   - i. Describe the structure of the ear.
   - j. Explain how you should take care of any two sense organs.
   - k. What are the ways in which germs spread?

3. State the difference between the following:
   - a. third rib and eleventh rib
   - b. tendon and ligament
   - c. hinge and angular joints

d. striped and cardiac muscles
e. mixed and motor nerves
f. viruses and bacteria

4. Tick the correct sentences. Correct the ones that are incorrect.
   a. Muscles are attached to bones by ligaments.
   b. A ball and socket joint provides maximum movement.
   c. Cardiac muscles are branched and striped.
   d. Motor nerves carry impulses from sense organs to the brain.
   e. The autonomic nervous system regulates the functions of internal organs.
   f. Four out of the five sense organs are located in the head.
   g. Food, moisture and suitable temperature are necessary for microbes to multiply.
   h. All bacteria are harmful to us.

5. State to which part of the skeleton (skull, backbone, ribs, girdle, breastbone and limbs) I belong:
   a. I serve as a site for the attachment of ribs in front.
   b. The limbs are attached to me.
   c. I am made up of 33 bones.
   d. I am made up of several flat bones fitted together, of which only one is movable.
   e. Some of my bones are attached by hinge joints.
   f. I have long curved bones and protect a very important organ.

6. Fill in the blanks:
   a. Bones are .... in children and .... in adults.
   b. The spinal cord passes through openings in the ....
   c. .... together with ...., enable bones to move.
   d. Each girdle is made up of .... and ....
   e. The .... helps you fold your arm and .... to straighten it.
   f. A bundle of nerve fibres forms a ....
   g. The .... coordinates the movement of muscles.
   h. Light passes through the ....
   i. The tongue is sensitive to .... and ....
   j. Diseases caused by microbes are ....

7. Draw neat labelled sketches of the following:
   a. bones of the limbs
   b. a nerve cell
   c. an eye

12. Houses of various kinds

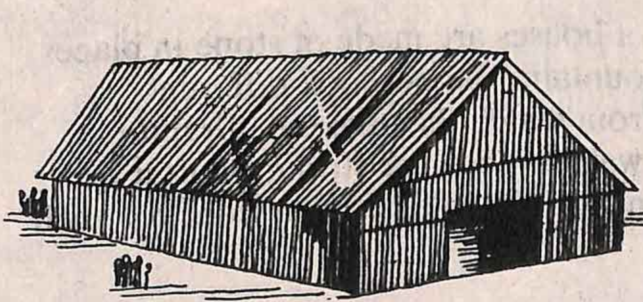
A house is a building that provides shelter, comfort and protection against wild animals, harmful insects, thieves and harmful climate such as severe heat, cold or rain. Houses range in size from small huts to huge mansions. People build houses suitable to the climatic conditions of the places where they live and also according to their capacity to spend on it.

The houses we live in

Comfortable houses in cities, towns and even in villages are usually built strong so that they cannot be damaged by wind, rain, heat and cold. They are usually built in such a way that they will be comfortable in any weather.

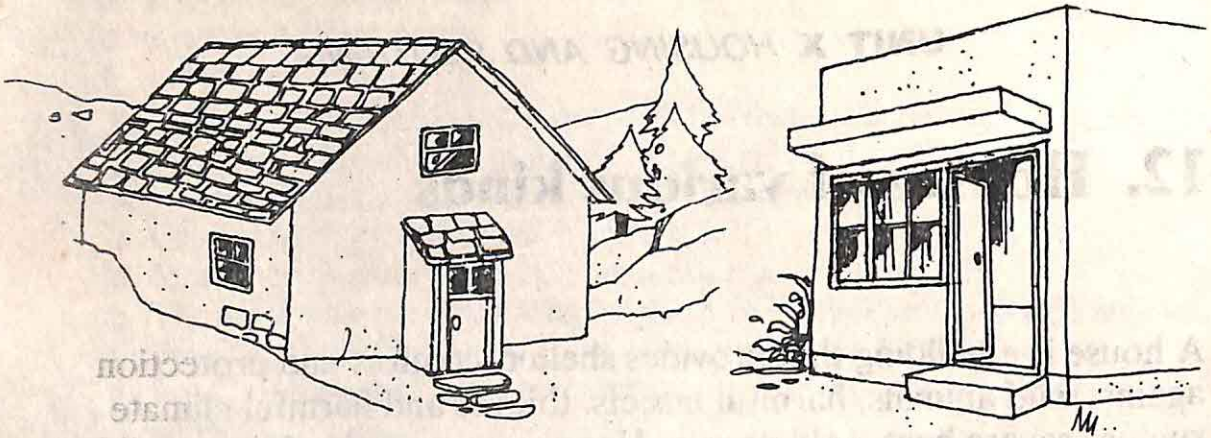
House building materials

The roof: We need to cover our houses with a roof that can keep out rain water, snow and the heat of the sun. So we require strong and water-proof materials for roofing. Roofing is done with clay, stone tiles, slates, palm leaves, straw, corrugated iron or corrugated asbestos. These roofing materials are less expensive than brick and concrete roofing materials which are used in modern houses.



A roof of corrugated iron

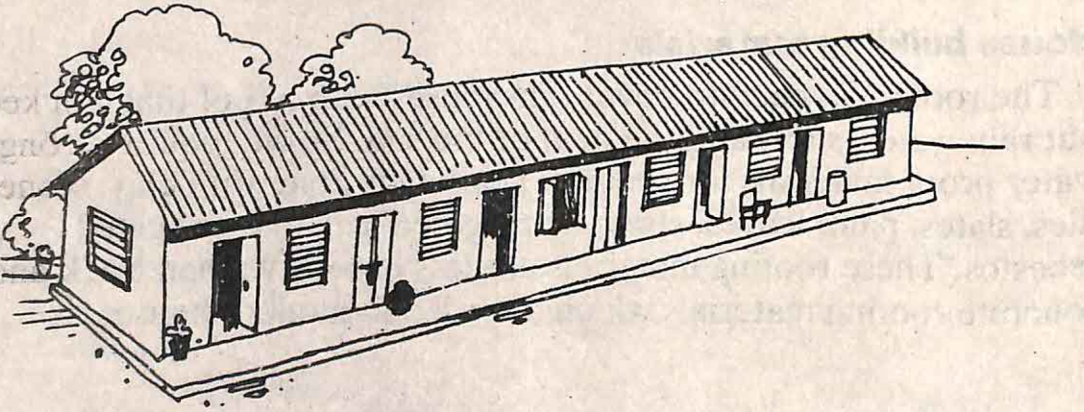
A straw roof



Walls, whether of brick or mud, are often whitewashed.

The walls of our brick houses: Some houses have compound walls all round them. Row houses in streets do not have compound walls. In many houses, walls are doubled. The double walls keep us warm in winter and cool in summer. Mortar or cement is used in between the bricks while building walls. Brick walls are plastered with mortar and cement. Then they are whitewashed or painted. Bricks are usually made of clay. They are baked in kilns to make them hard.

Walls are built of stone, mud or brick plastered with mortar and cement.



Stone and mud walls: Walls of houses are made of stone in places where stone is quarried from mountains. Stones look different according to the type of rocks from which they are cut. Granite stones are popular for building walls as they are strong. Mortar or cement is used between the stones and no plastering is done for such walls.

Mud walls are built using clay. Sometimes, straw or coconut fibre or powdered chalk or broken slate is also mixed with clay. Whatever mixture is made, it should be soft and wet like mortar. Some mud walls are even two feet deep. They can also be whitewashed. Stone and mud walls usually have thatched roofing.

Doors and windows

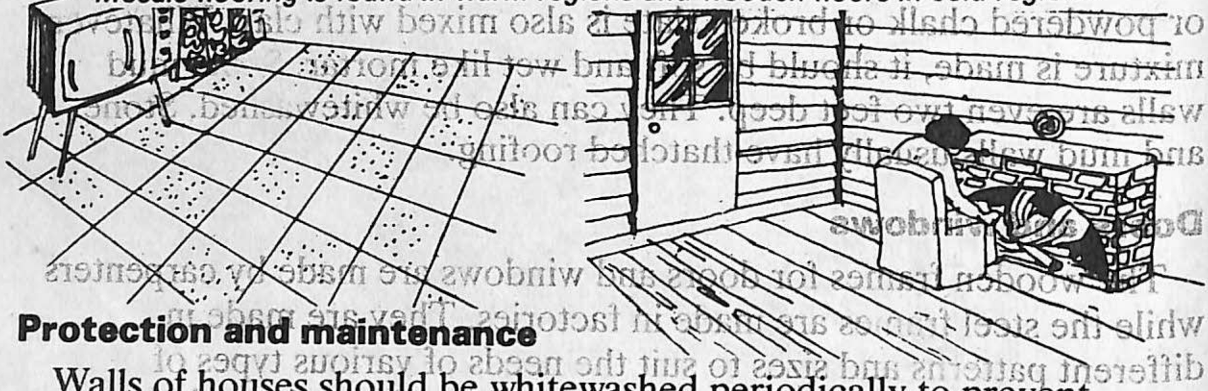
The wooden frames for doors and windows are made by carpenters while the steel frames are made in factories. They are made in different patterns and sizes to suit the needs of various types of houses built in different climatic regions. Sometimes glass window panes are fixed into the frames. Doors and windows permit the entry of air and sunlight into the house.

Doors and windows allow air and sunlight to enter the house.

Floors : Floors of huts and village houses are often made of clay. Small houses have cement floors or floor tiles. Modern houses have mosaic flooring. These types of floors are found in warm regions. Wooden floors are found in cold regions. Whatever flooring material is used, the floor should be smooth, so that it can be kept clean. Wooden houses called chalets are built in the snow-bound mountains of Switzerland.

Houses in warm regions must have high ceilings to keep us cool in summer, whereas low ceilings keep us warm in winter in cold regions.

Mosaic flooring is found in warm regions and wooden floors in cold regions.



Protection and maintenance

Walls of houses should be whitewashed periodically to prevent dampness and to keep them clean. Iron girders and railings should be painted and varnished to prevent rusting. Wooden framework should also be painted and varnished to keep away termites. Flooring should be swept and wiped clean and dry. Proper care and protection keep a house clean and bright for several years.

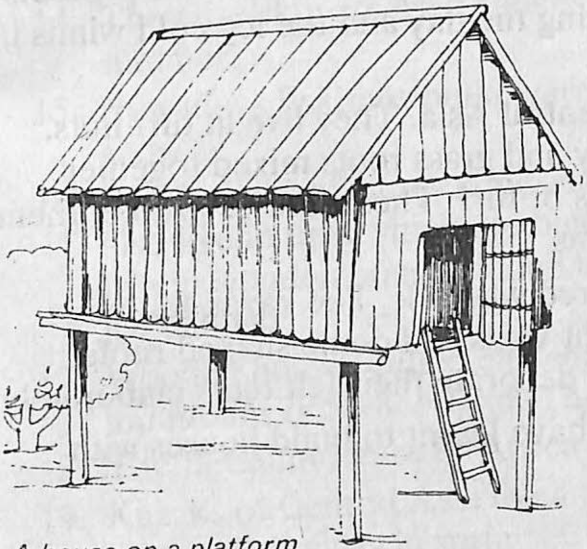
Houses of other people

People in many countries live in houses as we do. People who live permanently in one place can build such houses to live in. There are many nomadic tribes in many parts of the world. They wander from place to place in search of food. So they build suitable houses in different seasons.

People who live in the jungles like the pigmies of Africa build their houses using leafy branches which they collect from the jungle. They arrange them round a large tree trunk. Such a house looks like a huge beehive and it is provided with a wide front door. The interior is shaped like a cone. They build such houses within one or two hours! This type of house is called a leaf-shelter. It protects the jungle people from the heat of the sun and also from the rain.

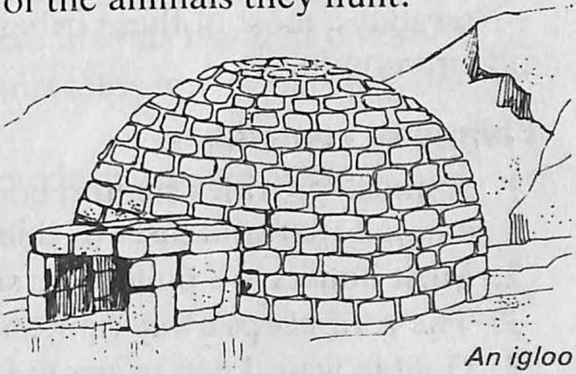
Summer houses in the jungle are also made of grass. The jungle people collect long sticks and tie them together at the top and spread them out at the edges to form a circle. They leave a wide space for the doorway and cover the remaining space with piles of long grass. They weave grass to make a door. These houses look like grass beehives. Such jungle houses are usually built close to one another. Where there is danger from wild animals, people build houses on platforms. They reach these houses by ladders. Sometimes they build small houses even on tree tops! These are tree houses.

Some people live near rivers where the water often floods the banks. So they build their houses on posts. These are called stilt houses. These houses are also reached by ladders. Stilt houses are also found in places where the ground always remains moist due to heavy rainfall. Bamboo poles are used as posts.



A house on a platform

People who live by the frozen shores of the Arctic Ocean in the north pole are called Eskimos. They live in the northernmost parts of North America and Greenland. They have a very short summer and a long winter. During their short summer, they build tents covered with the skin of the animals they hunt. They use the skin of seal and caribou for this purpose. They use wooden poles as a framework for their houses if they can buy them by selling their skins. They also make use of whale bones or the tusks of the narwhal for this purpose.



An igloo

In winter, they make snow houses called igloos. They are low houses built of blocks of frozen snow. They use transparent ice for windows. They build a long, snow tunnel leading to the door. This tunnel keeps away strong, cold winds. They have to crawl through the tunnel to enter into their houses! Nowadays they build warm, comfortable homes under the snow.

The natives of North America were called Red Indians. Some of them still live in their traditional tents called wigwams. They are nomads and carry their wigwams from place to place when they go hunting. Nowadays some of them live in log cabins. Some other Red Indian tribes live in tents called tipis. They are bigger than wigwams.

Log cabins are built in the coniferous forests where the lumbermen live. They are built of logs of wood and hence the name.

Bedouins are nomadic Arabs who live in the Arabian deserts. They live in tents made of cloth woven with black goat's hair. This protects them from the heat of the sun during the day and the icy cold winds in the night.

Kazaks are nomadic tribes of central Asia. They live in turf huts. They have mud walls made of clay and grass roots mixed together. Their roofs are covered with reeds or turf. These houses protect them from the terrible winter snowstorms.

In spring they live in tents covered with felt. The kazak felt tents are called yurts. Yurts have straight walls and dome-shaped roofs. Kazaks make their own felt. They decorate their felt tents elaborately.

Nowadays, most of these tribes have learnt to build houses with modern comforts.

Things to remember

1. A house provides shelter, comfort and protection against wild animals, harmful insects, thieves and harmful climatic conditions.
2. Most houses are built to be strong and lasting.
3. The roof keeps away rain, snow and the heat of the sun.
4. Double walls keep us warm in winter and cool in summer.
5. Bricks made of clay are baked in kilns to make them hard.
6. Plastering is done for brick walls. No plastering is required for granite stone walls.
7. Doors and windows are made of wood or steel. Glass panes are also fixed in them.
8. Doors and windows bring in air and sunlight.
9. Floors should be smooth to keep them clean.
10. The pygmies of Africa build leaf-shelters to protect them from heat and rain. Their summer houses are made of grass. Their

houses look like beehives and are built close to one another.

11. Tree houses and houses built on platforms keep away wild animals. They are reached by ladders.
12. Stilt houses are built on river banks or in marshy areas. Here, also, ladders are used.
13. Eskimos in the far North build igloos in winter and tents made of animal skins in summer.
14. They use skin-covered canoes called kayaks for fishing in summer.
15. Nowadays Eskimos build warm, comfortable houses under the snow.
16. Red Indians of North America live in tents called wigwams. They also live in tipis which are bigger than wigwams. Nowadays they live in wooden houses called log cabins. Lumbermen also live in log cabins.
17. Wooden houses called chalets are built in the snow-covered mountains of Switzerland. They are very comfortable houses.
18. The Bedouin Arabs of Africa live in tents made of cloth.
19. Kazaks of Central Asia live in turf tents in winter. They build felt tents called yurts in spring.
20. Any type of house, ancient or modern,is made as comfortable as possible to live in.

Things to do

1. Collect pictures of various types of ancient and modern houses and display them on your class display board.
2. What materials are used to build houses in your city or village? Make a list of them.
3. Draw a picture of your house and write short notes on it.
4. Whenever you visit a new place, make a note of the climate in that region and observe how houses are built there to suit that climate.
5. Find out what new materials are available for house building in different countries.

Exercises

1. Answer briefly:
   a. What type of roofing does your house have? Does it suit the climate of the

place where you live?

b. Why should roofing be made waterproof?

c. How do double walls help us?

d. Where are wooden floors found?

e. Give a list of various roofing materials.

2. Answer in detail:

a. How are doors and windows built? Why?

b. Describe how walls are built and plastered.

c. Describe the structure of an igloo.

3. Identify the following and write suitable notes:

a. kayaks

b. chalets

c. bee-hive houses

d. stilt houses

e. tree houses

f. log cabins

g. wigwams

h. yurts

13. Simple procedures in first aid

What is first aid?

First aid is the immediate and temporary care given to the victim of an accident or a sudden illness. Training in first aid is very useful and important as many lives can be saved by giving proper emergency care before the doctor arrives.

A first aid kit

A first aid kit is one which has essential emergency materials in it such as sterilised cotton, gauze, gauze pads, scissors, tourniquet, cellotape, hot water bag, medicine dropper, alcohol (for cleaning the skin), a pair of pincers, a torchlight and soap, along with some medicines like tincture iodine, tincture benzoine, mercuro chrome, boric powder, vaseline, ointments and turpenti

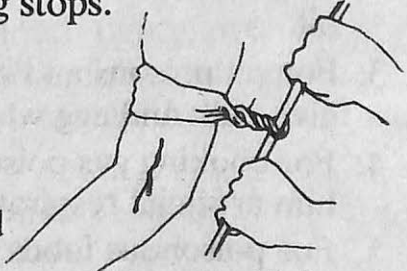
Urgent needs for first aid

In emergencies such as severe bleeding, poisoning or stoppage of breathing, the victim must be given immediate and efficient first aid. Or else he will die before the doctor arrives.

How to control bleeding

Make a pressure pack by folding sterilised gauze or clean, soft, white cloth. Place the pressure pack carefully over the bleeding area and press firmly. Hold it in place until bleeding stops.

Use of tourniquets

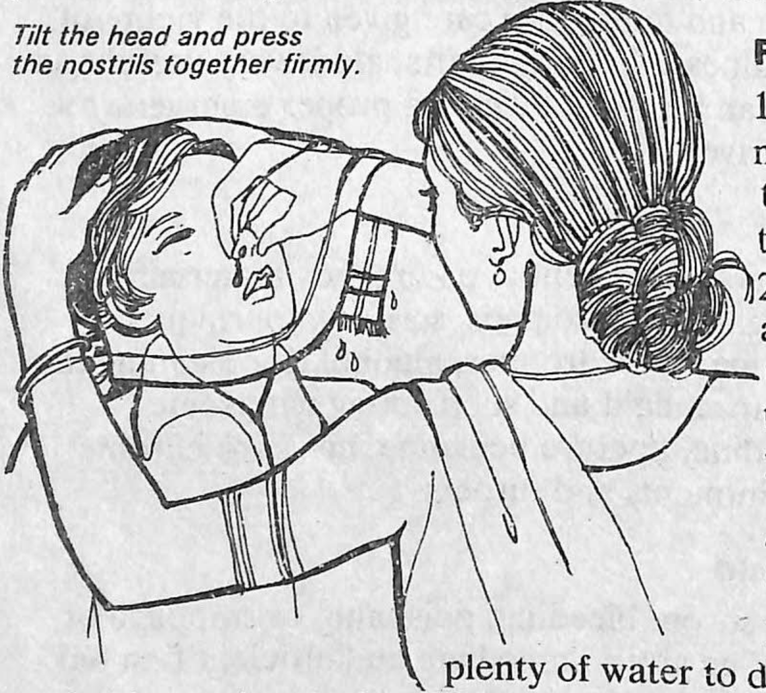


A tourniquet helps stop bleeding

If blood vessels in the arms or legs are cut, pressure packs cannot stop the bleeding. The supplying blood vessels should be blocked by using tourniquets. Bind the arm or the leg between the wound and the body with a long piece of clean cloth and tie the cloth to a wooden rod or ruler. Wind it tight until the bleeding stops.

How to stop nose bleeding

Keep the victim in an upright position and tilt the head slightly backward. Press his nostrils together firmly and place a wet towel over his face. This stops bleeding within a few minutes. If there is profuse bleeding even after a few minutes, call a doctor.



Tilt the head and press the nostrils together firmly.

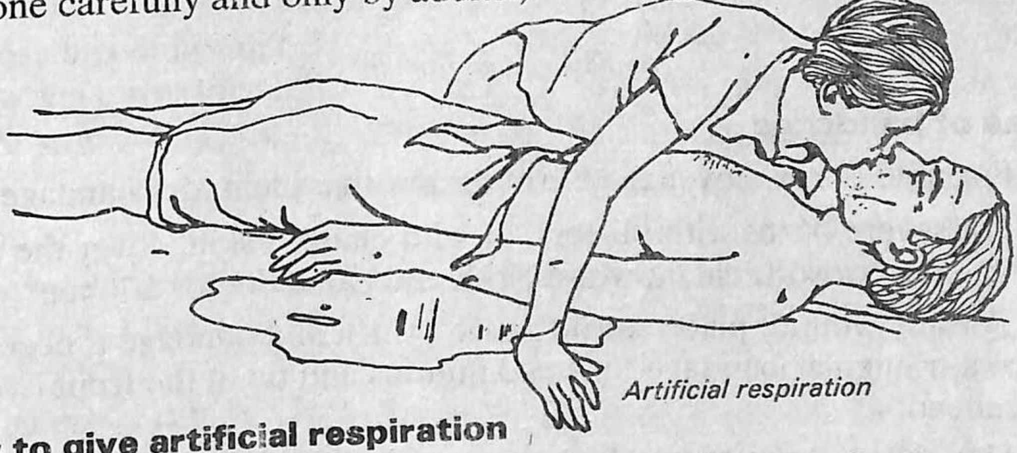
First aid for poisoning

1. Give plenty of water or milk to the victim in order to dilute the poison in the blood.
2. Give the necessary antidote which removes the effect of poison in the blood.
3. Call a doctor at once.

Antidotes for some common poisons

1. For strong acids, give plenty of water to dilute the acid. Then give baking soda solution. This reacts with the acid and makes it harmless. Give milk, egg white or olive oil to cover up the lining of the digestive canal and prevent the acid from corroding it.
2. For strong alkalies, give plenty of lime juice or orange juice or even vinegar diluted with water. Then give milk, egg white or olive oil.
3. For rat poisons and insect sprays, give plenty of water first. Then give milk and egg white.
4. For cooking gas poison, allow the victim to get fresh air and give him artificial respiration.
5. For poisonous foods, like poisonous mushrooms or toadstools, give strong tea and then castor oil.

6. For drugs that induce sleep, give the victim plenty of coffee and make him walk. If he is unconscious, call a doctor at once. If breathing stops, give artificial respiration at once.
7. For insect bite, apply cold water or a paste made of baking soda and cold cream. Apply an ice cube to give relief from the pain and swelling. Call a doctor if the swelling is excessive.
8. For animal bites (dog bite) wash the area immediately with soap and water. Call the doctor. Watch the animal for signs of rabies, a disease which affects dogs and can be passed on to human beings through a dog bite.
9. For bites from poisonous snakes, apply a light bandage above the wound. Then make cuts, about ¼ inch deep, over the bite, suck the blood out and spit it out. Make sure that you do not have an open wound in your mouth when you do this or else the poison will affect you. Use a knife or blade with no rust on it. (This should be done carefully and only by adults.)



Artificial respiration

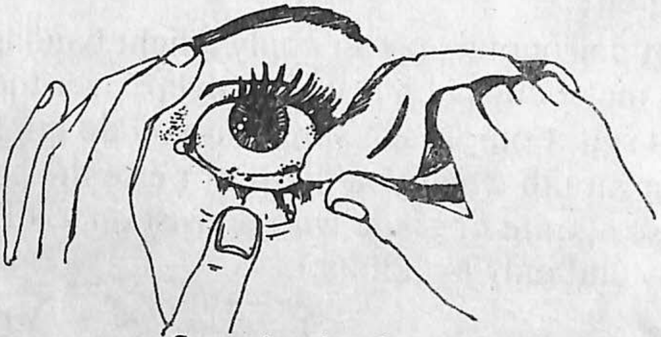
How to give artificial respiration

Mouth to mouth method: Remove any food material, if present, from the mouth of the victim. Place him on his back. Pull his jaw forward and hold it in position. Place your mouth tightly over the victim's mouth. Blow air gently and steadily into his mouth until he starts breathing on his own. Do this 12 times a minute for an adult and 20 times a minute for a child.

The other two methods called the chest pressure—arm lift method and the back pressure—arm lift method should be done only by trained persons, by placing the victim on his back in the first case and face down in the second case. Artificial respiration is required in cases of drowning or fainting due to electric shock.

How to remove dust from the eye

Do not squeeze the eye with your hand as it is a very sensitive organ and may be damaged. Pull the lower eyelid down. If you can see the dust particle, remove it with the corner of a folded clean cloth. Or else, draw the upper eyelid downwards. Allow tears to collect and then roll down, bringing the dust along with it. Then wash the eye with clean water. Eye injuries should be treated only by a doctor.



Removing dust from the eye

Use of bandages

For mild burns, cover the burnt area with a plain, dry bandage.

For severe burns with blisters, or with charred skin, cover the area with gauze or soft, clean, white cloth and call a doctor at once.

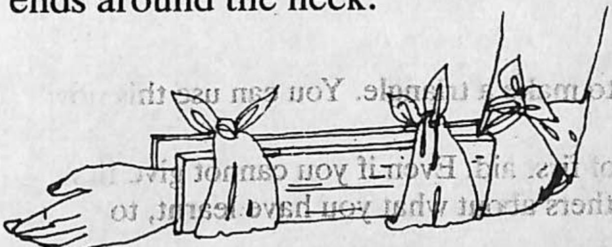
For any wound, place sterile gauze over it and bandage if necessary. Use a triangular bandage for head injuries and tie in the front over the forehead.

Use rolled gauze to bandage an arm or a leg. Tie it up at the wrist or at the ankle. Bandage the wounded area securely, but not tightly, in place.

First aid for fractures

Use splints to keep the broken bones and the adjacent joints in position. Tie the splints securely but not tightly in place, using gauze or cloth.

To make a sling for a fractured arm, place the arm across the chest and use a triangular cloth to support the arm. Tie its narrow ends around the neck.



Use splints to keep broken bones in position.

Make a sling for the arm.

Things to remember

1. First aid is the immediate and temporary care given to the victim of an accident or a sudden illness.
2. Training in first aid is important as it can save lives.
3. A first aid kit must contain all the essential things used in first aid.
4. Pressure packs are useful in controlling bleeding.
5. If blood vessels of the arms or legs are cut, tourniquets are used.
6. Nose bleeding can be stopped by tilting the head backwards and placing a wet towel over the face, pressing the nostrils together.
7. For stomach poisoning, drink plenty of water or milk.
8. For cooking gas poison, allow the victim to get fresh air and give him artificial respiration.
9. Give strong tea and castor oil to remove mushroom poison.
10. For insect bite apply cold water or a paste made of baking soda and cold cream.
11. If a person is bitten by a dog, wash the area with soap and water. Then take medical treatment.
12. Make cuts in the region of a snake bite and suck out the poisonous blood and spit it out.
13. 'Mouth to mouth method' is a simple method of artificial respiration.
14. Remove dust particles from the eye using the corner of a folded clean cloth. Wash it with clean water. Do not squeeze the eye.
15. Use triangular bandages for head injuries.
16. Use rolled gauze bandages for arm or leg injuries and tie up at the

wrist or ankle.

17. Use splints for arm fractures and put the arm in a sling.

Things to do

1. Take a big square cloth. Fold it across to make a triangle. You can use this now as a triangular bandage.
2. You are now aware of the importance of first aid. Even if you cannot give first aid to the needy, you can at least tell others about what you have learnt, to help them do it and save the victim.
3. See how nurses and doctors make a simple bandage. You can learn best by observation.
4. If regular splints are not available, you can always use rulers (scales) for making a sling. A towel can be used for making a triangular bandage.

Exercises

1. Answer briefly:
   a. What is first aid?
   b. Why is first aid important?
   c. What is the use of pressure packs?
   d. When do you use tourniquets?
   e. How can nose bleeding be stopped?
   f. What should you do immediately if you suspect stomach poisoning?
   g. When is artificial respiration given?
   h. What do you drink to get rid of mushroom or toadstool poison?
2. Answer in detail:
   a. What materials should a first aid kit contain?
   b. How can you assist a person with first aid if he fractures his arm?
   c. What should you do in case of (i) mild and (ii) severe burns?
   d. How will you remove dust particles from the eye without injuring it?
   e. What are antidotes? What common antidotes can you use for poisoning due to (i) acids; (ii) alkalies?

TEST PAPERS

Test Paper I

1. Answer briefly:
   - a. Name two each of aquatic, terrestrial, aerial and burrowing animals.
   - b. Why does a polar bear hibernate?
   - c. What special adaptations do desert animals have?
   - d. Why is the forest floor dark?
   - e. Give two examples each for layering, cutting and grafting.
   - f. Name the factors which spoil foodgrains.
   - g. Name the conditions necessary for germination.
   - h. Why should plants reproduce themselves constantly?
   - i. State the difference between browsers and grazers.
   - j. Which animals have long, sharp incisors? Why?
   - k. How do canines help carnivores?
   - l. What do anteaters do with their claws?
2. Answer in detail:
   - a. Describe life in a forest.
   - b. Describe the relationship between herbivores and carnivores in grasslands.
   - c. Describe the structure of desert plants. Why should they have such adaptations?
   - d. How are plants and animals well equipped for life on mountain slopes?
   - e. Describe an experiment to show the conditions necessary for germination of seeds.
   - f. How do suitable soil and climate help in the growth of plants? Explain with suitable examples.
   - g. Describe the necessary storage facilities required for foodgrains.
   - h. What measures should be taken for protecting crops and improving crop production?
   - i. Describe the feeding habits of the following birds: spoonbill, owl, kingfisher.
   - j. How and why are the limbs of herbivores thin and long?
   - k. Which animals have prehensile tails?
   - l. Describe the flight adaptations in birds.
   - m. Describe how certain plants like duckweed and water hyacinth float in water.
   - n. Where do seaweeds grow in the oceans? Why?
3. Fill in the blanks:
   - a. .... animals have long limbs and powerful horns to escape from or

fight with their ....

b. The cheetah is a good .... and has large, sharp canines called ....

c. Fangs of poisonous .... inject poison into their .... which kills them.

d. The .... licks up insects with its long, ... tongue.

e. The .... protects the seeds until they ....

f. .... or .... contain food materials in seeds to supply it to the miniature plant.

g. A covering of .... prevents the entry of .... into water. So seeds kept in that dish cannot germinate.

h. Gardeners make wide use of .... for raising plants which give us flowers and fruits.

i. Green plants have .... in their .... with which they can prepare their own food.

j. Animals that feed on plants directly (herbivores) are called ....

k. Animals (carnivores) which feed on herbivores are called .... and .... consumers.

l. .... feed on dead animals killed by other carnivores.

4. Match the following:

a. tracheae	crawl on the ocean floor
b. porpoise	hairy roots, and air spaces in leafstalks
c. lobsters	keep the body of insects light
d. duckweed	underground stem
e. frog	exhibit slow movement
f. water hyacinth	sea mammal
g. polar regions	have root pockets
h. potato	exhibits swift movement
i. plants	cold deserts
j. cheetah	breathes through skin while under water

5. Identify the following:

a. Wind, animals, birds, insects and water are used for this. ....

b. This softens and weakens the seed coat. It also helps to convert insoluble food stored in the seed into soluble ones. ....

c. This storage root is used in vegetative propagation. ....

d. This crop needs well-aerated, sandy soil. ....

e. The method of alternating crops in different seasons for a better yield. ....

f. Many fish have this organ to let them float in water. ....

6. Identify the environment for the following:

a. eucalyptus tree	f. cactus
b. whale	g. arctic fox
c. mountain goat	h. hydrilla
d. camel	i. squirrel
e. zebra	j. mole

Test Paper II

1. Answer briefly:
   - a. What will the earth be like without a blanket of air?
   - b. What work do the weather satellites do?
   - c. How can you show that one matter can displace another?
   - d. What is compressed air?
   - e. How can a vacuum be created in a tin can?
   - f. What happens to safety pins and needles if left unused in the open for a long time?
   - g. Which are the two chief gases of the air? Which one of them is active and which one is inactive?
   - h. Which part of the air condenses into dew?
   - i. Give two examples each for slow and rapid combustion.
   - j. Air will be unfit for breathing without green plants. Why?
   - k. How do we get salt from sea water?
   - l. Where did ancient civilizations actually flourish? Why?
   - m. In what form do we give out water from our bodies?
   - n. Which materials settle down when flood waters recede?
   - o. Which is a sure method of removing dissolved impurities from water? Where and why is it done?
2. Answer in detail:
   - a. Describe a suitable method by which you can remove chalk powder mixed with water.
   - b. What is chlorination? Where and why is it done?
   - c. What is a crystal? How can you prepare sugar crystals at home?
   - d. When you add sugar to milk, what happens? Which space does it occupy? When?
   - e. How can you show by a simple experiment that living things make use of only oxygen from the air for breathing?
   - f. State the differences between the compositions of inspired and expired air.
   - g. State the causes for air pollution and describe how it affects us.

h. You are given a basin of water, a cork and a glass tumbler. Show that air exerts pressure.
i. How can you 'glue' two glass tumblers together? Explain.

3. Pair the following experiments with their principles.

Experiments	*Principles*
a. siphon	air occupies space
b. bell jar experiment	removal of heavy, suspended impurity
c. experiment using tumbler and kerchief	air pressure
d. distillation	air exerts pressure on all sides
e. balloon experiment	composition of air
f. decantation	recovering the solute from the solution
g. filtration	preparation of pure samples of the solute in crystalline form
h. tin-can experiment	getting the purest form of solvent (liquid)
i. evaporation	air has weight
j. crystallisation	removal of light, suspended impurities

4. Identify the following and explain their meaning.
   a. universal solvent
   b. invisible ocean
   c. lime water
   d. atoms
   e. self-filler pen

5. Mention one important use for each of the following:
   a. nitrogen
   b. carbon dioxide
   c. oxygen
   d. presence of water vapour in the air
   e. air pressure
   f. syringe
   g. siphon
   h. water sprinkler
   i. retort
   j. force of waterfalls

6. What do you observe from the following?
   a. When a lump of common salt is exposed to air.
   b. When a glass tumbler is held inverted over a burning candle.
   c. When an empty ink filler is dipped into ink and its bulb pressed.
   d. When a cycle tube punctures.

e. When a liquid is sucked into a drinking straw and its top is closed by a forefinger.

7. In which experiments are the following used?
   a. a rubber sucker
   b. a wet blotting paper ring or collar
   c. a tumbler filled with water and a cardboard
   d. a water bottle
   e. a T-shaped cardboard
   f. a mirror or a slate
   g. a balloon and a tumbler
   h. a rubber tube

Test Paper III

1. Answer briefly:
   a. Which heavenly bodies 'blink' and which of them twinkle?
   b. What are earthlight and moonlight?
   c. Name the planets of the solar system in the order of their nearness to the sun.
   d. Which planets of the solar system are called the giants? What do each of them have around them, and to what depth?
   e. How far is the earth from the sun?
   f. Which minerals are normally found in granite rocks?
   g. What is an ore? What are the types of ores? Give two examples each.
   h. What are precious gems? Name any two common ones which you have seen.
   i. What is generated using the heat energy produced by burning coal?
   j. What is L.P.G.?
2. Answer in detail:
   a. How are sedimentary rocks formed? Give five examples of common inorganic sedimentary rocks you know.
   b. What is the result of volcanic eruptions on the surface of the earth? Describe.
   c. Name any four commercially important minerals. Mention one important use for each of them from what you see in your everyday life.
   d. Write short notes on the following:
      i. shale; ii. conglomerate; iii. Pluto; iv. morning and evening star; v. pumice.
   e. What are organic rocks? What do you know about them?
   f. What fuel does the sun have? How does it produce enormous energy?

g. Write two sentences on each of the following:
   i. moon's gravity; ii. fuels under the earth's surface; iii. annular eclipse; iv. manures; v. complete fertilisers.

h. What is an eclipse? When do solar and lunar eclipses occur?

i. How are tides caused? What are spring tides and neap tides?

3. Identify the following:
   a. Natural satellite of the earth.
   b. The planet about which we still do not know much.
   c. The conversion of this gas into helium produces enormous energy in the sun.
   d. This is a metamorphic rock which takes high polish. So it is used in buildings.
   e. This rock is called volcanic glass.

4. Tick the correct sentences. Correct those which are incorrect.
   a. Earthquakes must have changed metamorphic rocks into sedimentary rocks.
   b. Granite is an example of deep-seated igneous rock.
   c. Dull lumps of minerals, when cut and polished, turn into precious gems.
   d. Animals get the minerals they need, directly from the soil.
   e. Corals are examples of sandstone rocks.

5. Place the following under suitable columns given below.
   a. This has an orbit of its own and travels round the sun.
   b. This always travels along with its planet around the sun.
   c. This is a star, our nearest star.
   d. This borrows light from the sun.
   e. This produces enormous heat and light energy.
   f. Our moon belongs to this type of heavenly body.

Property of a planet	Property of the sun	Property of a satellite
Example		
a		

6. Identify each of the following as igneous, sedimentary or metamorphic rock.
   a. Basalt covers the Deccan plateau.
   b. Quartzite consists of quartz grains.

c. Shale splits easily.
d. Conglomerate is called the 'pudding rock'!
e. Pumice is a spongy, light rock.
f. Slate is got from shale.

Test Paper IV

1. Answer briefly:
   - a. Name any four simple machines you use in everyday life.
   - b. What simple machine did the caveman use? How?
   - c. What is a wheelbarrow? Which type of simple machine is it?
   - d. How can you compare your arm to a simple machine?
   - e. Give an example of a modified inclined plane. Explain how it is used.
   - f. Which simple machine requires a grooved wheel?
   - g. Equal volumes of cotton and iron balls do not weigh the same. Why?
   - h. A toy boat floats but a tiny marble sinks in water. Why?
   - i. An object that floats in water sinks in kerosene. Why?
   - j. What is a lactometer? How can you use it?
   - k. What is the marking on the ship's hull called? How is it used?
   - l. Which is the densest of liquids you know?

2. Answer in detail:
   - a. What is density? What is the density of water? Why is it taken to be the standard for the measurements of density?
   - b. A complex machine is only a combination of simple machines. Explain.
   - c. How does a ship float in water, in spite of being heavily loaded?
   - d. What are the three types of levers? Give an example of each and explain how each of them work.
   - e. Who discovered the law of levers? What does the law say? Explain with an example.
   - f. A third class lever is never used to lift heavy objects. Why?
   - g. Name the types of inclined planes you use in your daily life. How and when do you use them?
   - h. A wedge is not merely used by a labourer but is also used in the kitchen everyday. How?
   - i. What is a wheel and axle? Explain its function with an example.
   - j. How do we make use of a screw in different ways? Explain with examples.

3. **Name the type of simple machine for each of the following:**
   - **a. carpenter's plane**

b. fishing rod
c. a pair of scales
d. a pianist's chair
e. a winding stairway
f. a fly-over
g. a nut-cracker
h. a car steering
i. a grooved wheel used in a flagpost

4. Group the following as objects which will float in water or sink in water:
a. ice cube; b. paper; c. wooden plank; d. straw e. cork; f. nail; g. pencil; h. pen; i. metal spoon; j. plastic cup; k. sawdust; l. nylon rubber

5. Discover and list the simple machines that are used in a sewing machine.

6. Show by means of diagrams how a test tube will float in a. water; b. milk; c. kerosene. In which liquid does it sink the most? Why? In which does it sink the least? Why?

Test Paper V

1. Answer briefly:
a. What are bones made of?
b. Give two examples of flat bones.
c. Give an example of an immovable joint.
d. What is the cranium?
e. What is bone marrow? Where is it found? What does it contain?
f. Which organs are protected by the rib cage?
g. What are girdles?
h. Which joint allows one-sided movement only?
i. What are voluntary muscles? Why are they called so? Give an example.
j. What is the main function of the nervous system?
k. What are mixed nerves?
l. What is the central nervous system made of?
m. What happens when you catch a severe cold?
n. Which part of the body acts as a sound gathering trumpet?
o. To which things is the inside wall of the eye sensitive?
p. What do you use to give first aid for fractures?
q. When do you give artificial respiration?
r. What can you do to get rid of food-poisoning by mushrooms or toadstools?

s. What is mortar? How is it used?

t. Where do lumbermen live?

2. Answer in detail:

   a. Give a short description of the three types of muscles.

   b. What are the four types of joints? Describe their functions with an example for each.

   c. Describe briefly the function of the eye.

   d. Name the main parts of the skeletal system.

   e. What are backbones?
   How many vertebrae do we have?
   How are they arranged?
   What do they protect?

   f. Describe the general functions of sensory and motor nerves.

   g. Muscles work by pulling, not by pushing. Explain with an example.

   ~~h.~~ Describe the importance of right posture.

   i. Why should we exercise and play games?

   j. Describe briefly, the functions of the three parts of the brain.

   k. What are tendons and ligaments? What are their functions?

   l. What is reflex action? Explain with an example.

   m. Give two examples each of useful and harmful microbes. Explain why they are useful or harmful.

   n. Describe the houses of any two nomadic people.

   o. State the first aid given for the following:
   i. snake bite; ii. poisonous food; iii. cooking gas poison; iv. nose bleeding.

3. Who am I?

   a. I am a fungus. I am used in baking bread.

   b. I belong to the family of protozoa. I cause malaria.

   c. I am an effective insect-killer.

   d. I am an irregular bone. I allow the spinal cord to pass through me.

   e. I am a type of joint. I help people to make use of various tools.

   f. If not properly used, I become weak and flabby.

   g. I am the brain stem. I control heart beat and breathing.

   h. I am found in the ear canal. I prevent dust and small insects from entering the ear.

   i. I act as windscreen wipers to protect the eyes.

   j. I can sniff everything you eat.

4. Find the suitable partner for each of the following:

   a. hip girdle
   b. triceps
   c. elbow
   d. ankle
   e. sensory nerve

5. Pair the following suitably.

muscle three tiny bones influenza **hookworms**
virus skin brain tongue polluted soil
taste buds ear cranial nerves cerebellum
little brain pressure and pain biceps

6. Match the following suitably:

a.

jungle	cloth tents	Kazaks
on the banks of flooding rivers	stilt house	Pygmies
natives of North America	leaf-shelter	Red Indians
Arabs	turf huts	ladder
Central Asia	wigwam	Bedouins

b.

tourniquets	medicine dropper	dog bite
gauze pads	plenty of water	fracture
rat poison	excessive bleeding	scissors
rabies	splints	milk and egg white
triangular bandage	wash wound with soap and water	blood vessels